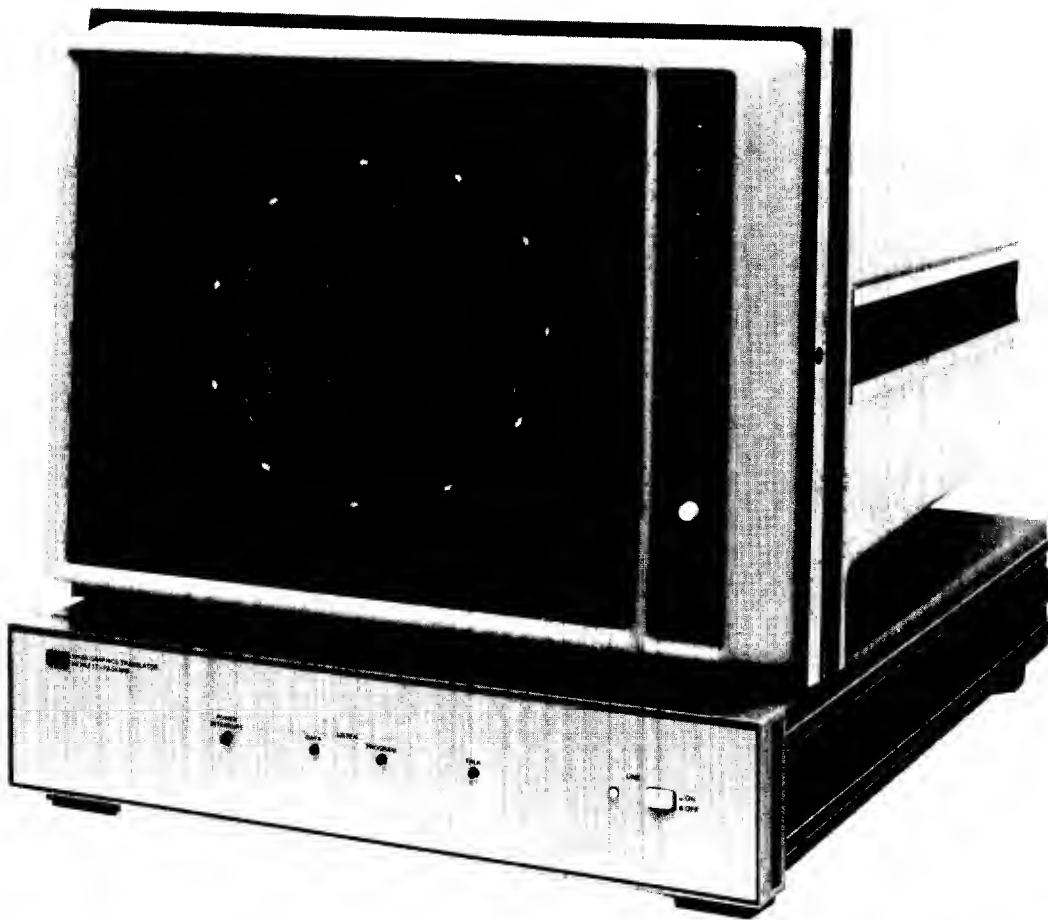


# *Operating and Programming Manual*

## **1350A Graphics Translator**



**HEWLETT  
PACKARD**

## **SAFETY SUMMARY**

***The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.***

### **GROUND THE INSTRUMENT.**

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

### **DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.**

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

### **KEEP AWAY FROM LIVE CIRCUITS.**

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

### **DO NOT SERVICE OR ADJUST ALONE.**

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

### **DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.**

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification of the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

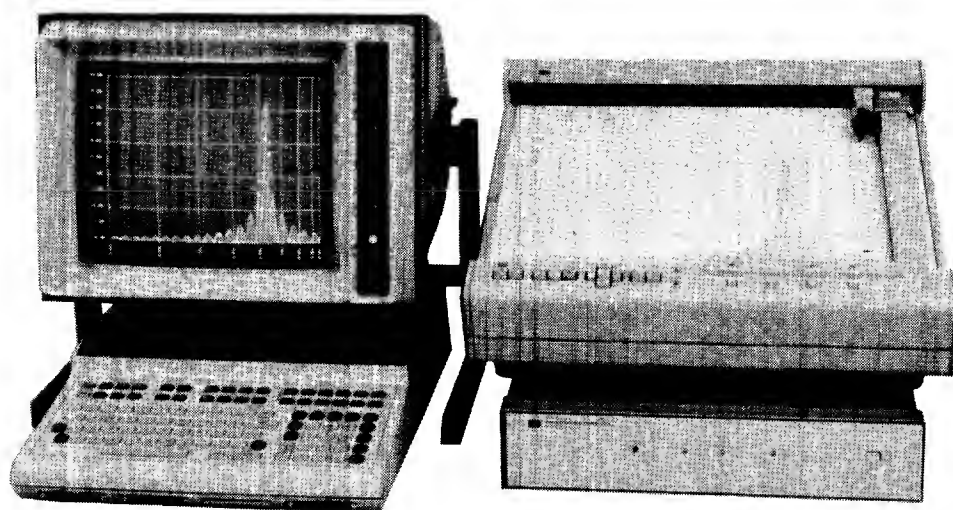
### **DANGEROUS PROCEDURE WARNINGS.**

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

**WARNING**

**Dangerous voltages, capable of causing death, are present in this instrument.  
Use extreme caution when handling, testing, and adjusting.**

## Model 1350A Graphics Translator



Model 1350A with Calculator, X-Y Display, and X-Y Plotter

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M. LAMBUTH  
T. RYAN

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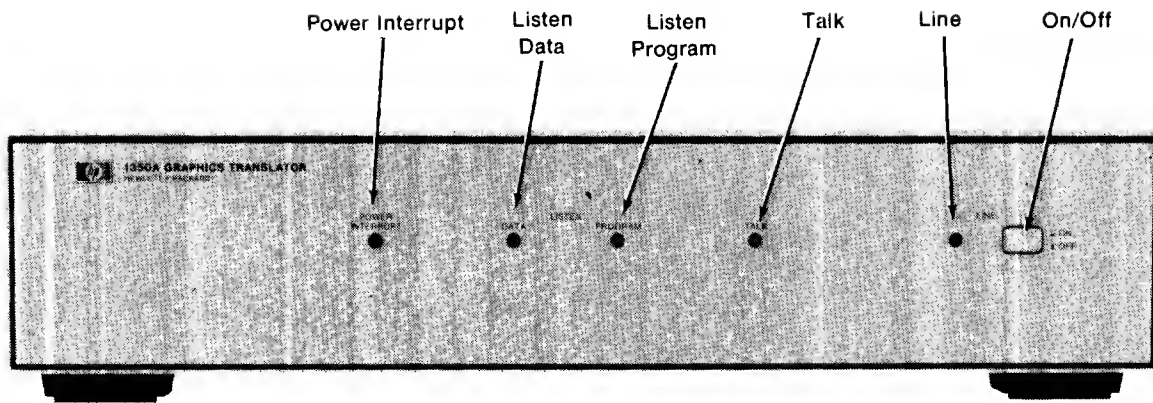
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# Overview



**Model 1350A Front-panel Controls and Connectors**

**Power Interrupt** - Indicates voltage changes in AC power that could cause HP-IB bus information or information stored in 1350A memory to be altered.

**Listen Data** - Indicates data is being transferred from the controller to the 1350A.

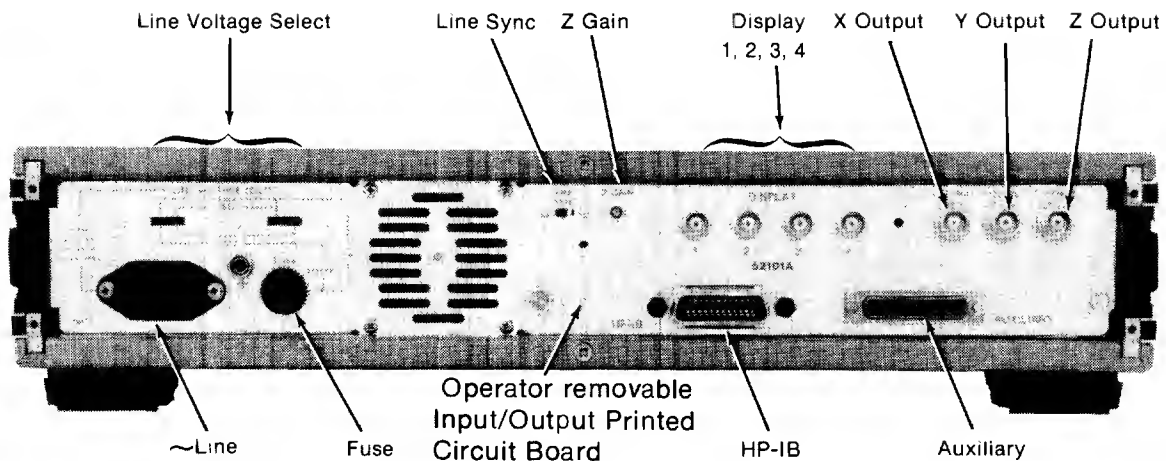
**Listen Program** - Indicates the 1350A has been addressed by the controller and the 1350A is "listening," ready to receive information from the controller.

**Talk** - Indicates the controller has given the 1350A a talk address and is waiting to receive data from the 1350A. This state should never occur, as the 1350A is not configured to transmit data to the controlling computer (HP-IB).

**Line** - Indicates if AC power line is on or off.

**On/Off** - Turns AC power line on or off.

# Overview



**Model 1350A Rear-panel Controls and Connectors**

**Line Voltage Select** - Selects desired AC line voltage.

**Line Sync** - Synchronizes 1350A to AC power line.

**Z Gain** - Adjusts output amplitude of Z axis signal.

**Display 1, 2, 3, 4** - Provides TTL blanking to four separate displays.

**X Output** - X axis analog output signal for display input.

**Y Output** - Y axis analog output signal for display input.

**Z Output** - Z axis analog output signal for display input.

**~Line** - Connector for AC power cord.

**Fuse** - AC line protection.

**HP-IB** - Connector for Hewlett-Packard Interface Bus Cable (from controller).

**Auxiliary** - Connector that has TTL blanking outputs (Display 1, 2, 3, 4) as well as information to control the Hewlett-Packard 1338A Tri-color Display. (More information may be found in Appendix C.)





# Chapter 1

## Introduction

### General

The purpose of the Operating and Programming Manual is to acquaint the 1350A GRAPHICS TRANSLATOR user with the system features and capabilities. Throughout the discussions, it is assumed that the 1350A is being used in combination with one or more CRT displays. In order to achieve a thorough understanding of the total performance available, the manual discusses three principals and interrelated areas: programming, hardware, and specific examples. Each area compliments the others, and the material should be considered as a whole. This manual and the Operating and Service manuals for the 1350A and the appropriate CRT display provide a complete system documentation package.

The manual is organized into six chapters as follows:

- **Chapter 1, Introduction**  
Manual organization, attributes of the 1350A, and system description.
- **Chapter 2, Graphics Overview**  
Concepts for using 1350A based graphics.
- **Chapter 3, General Programming**  
Instructions, syntax, function formatting, and initialization.
- **Chapter 4, Hardware**  
Functional block diagram, memory organization and structure, and display considerations.
- **Chapter 5, Extras**  
Unique features of the 1350A for controlling multiple displays and display files.
- **Chapter 6, Examples**  
Four different examples, each given in HPL, BASIC, and FORTRAN language.

The material in this manual is sufficiently complete to help implement the 1350A on any computer or controller system. The only requirement is that the host system support HP-IB (IEEE 488) or RS-232C with a hardware interface and an appropriate software device handler. In addition, the material in the manual is organized and indexed so as to serve as a quick reference guide.

# Attributes

Since the 1350A Graphics Translator provides a collection of graphics features and capabilities not previously available in one product, it is worthwhile to list the attributes.

The 1350A, when combined with an HP high-resolution display, gives excellent directed-beam graphics. In addition, it is an inexpensive computer peripheral which provides general-purpose graphics:

- generates both lines (vectors) and text characters
- supports from 1-4 displays simultaneously and independently
- capable of high-speed, interactive display updating
- has available plug-in interface modules for parallel HP-IB (IEEE-488) or serial RS-232C operation
- accepts high-level software commands.

The 1350A is also a cost-effective solution to a wide range of demanding graphics display application:

- reduces the host computer system overhead by providing external vector memory for updating and refreshing
- reliability is very high
- power requirements are low; nominally 150 watts for the 1350A and an HP large screen display.

## Description

From a functional point of view, the 1350A Graphics Translator consists of (see Chapter 4, figure 4-1):

1. a digital interface which receives ASCII coded instructions and data (HP-IB or RS-232C),
2. a graphics processor which controls the operations of the 1350A,
3. a digital memory which contains a description of the picture elements (in the case of a line, each of the locations of the end points), ASCII character and special control functions,
4. a vector generator which outputs the analog voltage to drive one of the HP directed beam X-Y-Z displays, and
5. four digital outputs which are used for controlling multiple displays.

Programming the 1350A is very similar to programming an intelligent plotter. There are 18 basic instructions which are expressed as a simple two character mnemonic. The instructions are centered around the concept that a graphics picture can be created by the positioning and status of a pen and by controlling files which contain pen strokes and/or character text. Table 3-1 in Chapter 3 contains a summary of the instructions.

Since the 1350A is an intelligent peripheral with its own instruction set, it can be implemented on any computer or controller system which can transmit an ASCII string of characters via HP-IB or RS-232C. This feature allows the 1350A to be used with any of the popular software languages (i.e., HPL, BASIC, FORTRAN, and PASCAL) without the need of special software device handlers. In addition, the 1350A can be easily integrated into existing user application programs or graphics software packages.



# Chapter 2

## Graphics Overview

### General Features

The 1350A and a CRT display provide the same functions as a conventional high resolution display by presenting lines and alphanumeric characters. In addition, it has the extremely important feature of high speed selective memory updating. Any single memory location or one of the 32 data files can be as easily changed as all of the memory. This feature provides the capability of dynamic display interaction. By simply changing the end points of a line, it is automatically redrawn in the new position during the next display refresh cycle. It should be remembered that the lines on the display are truly continuous lines and not a series of dots.

Another feature of the 1350A is that all input and output operations are fully interleaved. From a programming point of view, the 1350A continues to up-date the CRT display while new instructions and data are being transmitted to it. This feature, plus the above mentioned features, supplies user written software with the capabilities of image rotation, translations, and three-dimensional rotations.

### Concepts

In order to obtain the total benefits of a dynamic display system, the operation of the 1350A should be viewed as sketching a picture or filming a movie. Each picture and segment of the picture should be planned. In general, foreground features change more quickly and tend to be the center of attention. For this reason, it is often convenient to group like features in a single software/hardware file. This provides the convenience of updating a single file to change a feature or function. It also supplies a framework for order of priority when updating. For instance, the foreground may be updated 100 times for each time the background is changed.

## Variation

After reviewing the manual, the user is encouraged to try several variations of a display theme. Consider, for example, a simple straight line. Fix one of the end points and consecutively vary the other end point as a mathematical function  $y = f(x)$ . The display might contain a family of lines fanning out or one line moving by itself.

As an extension of the moving line theme, the next example could be the use of a square or rectangle. In this case, plot a four-sided figure on the display and fix two opposite corners while moving the other two. The result appears to be that of stretching a rubber band or perhaps revolving a surface about an axis.

The last suggestion for a variation is meant to demonstrate the capabilities for three-dimensional rotation and the relationship to file structures. A sense of three-dimensional rotation of an object can be obtained by placing various views in separate files, then sequentially displaying each view separately.

The following chapters will provide the details for implementing these simple examples and assist the user with specific applications.

# Chapter 3

## General Programming

### Introduction

This chapter discusses how to program the 1350A Graphics Translator from the viewpoint of what the 1350A must receive in order to perform its functions.

The first part of this chapter provides the formal programming rules.

The rest of this chapter is separated into the major 1350A functions of: (a) Initialization; (b) Drawing Vectors; (c) Displaying Text; and (d) File Operations.

Detailed explanations of 1350A commands are given under the functional areas where they most directly apply. Table 3-1 lists 1350A functions and their command subsets.

**Table 3-1. 1350A Functions and Command Subsets**

FUNCTION	ASCII COMMANDS		FUNCTION	ASCII COMMANDS	
Initialization	EM	Erase Memory	File Operations	NF	Name File
	EN	Erase Names		SN	Stop Naming
	EX	Erase auXiliary		FF	Find File
	BM	Blank Memory		EF	Erase File
	UM	Unblank Memory		BF	Blank File
				UF	Unblank File
Drawing Vectors	PA	Plot Absolute		FL	Find Location
	PE	Pen Enable	Multiple Displays (see Chapter 5)	WX	Write auXiliary
Displaying Text	CS	Character Size		SX	Stop auXiliary
	TX	TeXt			



## Formatting Rules

1. The 1350A receives all instructions in standard ASCII code; this is true for both the serial RS-232C interface and the parallel HP-IB interface.
2. All instruction commands are two letters (ASCII alpha characters).
3. The two-letter instruction commands may be either uppercase or lowercase. This manual will use uppercase characters.
4. All parameters are ASCII numeric characters (0 thru 9).
5. Each command consists of:
  - a. The two-letter command code.
  - b. A variable length parameter field (zero or more numerics, or a text character string).
  - c. A delimiter following any parameters.
  - d. A command terminator.
6. No spaces are allowed: (a) in front of a two-letter command; (b) between the two letters of a command; and (c) immediately prior to a terminator.
7. Following a Text (TX) command, the 1350A must receive an ETX (End of Text) character in order to exit text mode. After the ETX, the Text command must be terminated by a colon, or CR, or LF.

---

### NOTE

The ASCII End of Text (ETX) character can be obtained on most terminals by pressing the Control (CNTL) and capital C keys at the same time.

---

## Syntax

Table 3-2 gives a dictionary of parameter ranges for the command variables used by the 1350A.

< > Angle brackets denote a syntactical variable. The user must supply a value from the specified range of possibilities given for the item.

[ ] Square brackets denote required delimiters.

**Table 3-2. Parameter Items and Ranges**

ITEM	RANGE
<abs X>	0 . . 1022
<abs Y>	0 . . 1023
<enable>	0 . . 1
<size>	0 . . 7
<location>	0 . . 2047
<file>	0 . . 31
<display>	0 . . 15
<string>	Any group of ASCII characters, excluding the ETX (End of Text) character (3 in base 10).
<terminator>	: or CR or LF

## Command Terminators

Table 3-3 lists 1350A command syntax. The commands are listed in alphabetical order.

A colon (:), Carriage Return (CR), or Line Feed (LF) character must be used to terminate each command. Table 3-3 shows a <terminator> as the ending condition of each command.

If more than one <terminator> is received, the 1350A responds normally (as if only one <terminator> was received). For example, a colon at the end of a line may automatically be followed by CR/LF (as is often generated by interface drivers). Even though three <terminator> characters have been received, the 1350A only uses the first one.

---

**NOTE**

If parameter ranges are exceeded, or if formatting, syntax, and programming rules are not followed, then undesirable (and sometimes very confusing) displays can result.

---

**Table 3-3. Command Syntax for 1350A ASCII Commands**

COMMAND NAME	SYNTAX
Blank File	BF<file>[, <terminator>
Blank Memory	BM<terminator>
Character Size	CS<size>[, <terminator>
Erase File	EF<file>[, <terminator>
Erase Memory	EM<terminator>
Erase Names	EN<terminator>
Erase auXiliary	EX<terminator>
Find File	FF<file>[, <terminator>
Find Location	FL<location>[, <terminator>
Name File	NF<file>[, <terminator>
Plot Absolute	PA<abs X>[, <abs Y>[: <terminator>
Pen Enable	PE<enable>[, <terminator>
Stop Naming	SN<terminator>
Stop auXiliary	SX<terminator>
TeXt	TX<string> end text <terminator>
Unblank File	UF<file>[, <terminator>
Unblank Memory	UM<terminator>
Write auXiliary	WX<display>[, <terminator>

**NOTE:** Each comma (,) and semicolon (;) is a required item in the command string. The |end text| delimiter is the ASCII End of Text character (ETX = 3 in base 10).

## Programming Rules

1. The 1350A follows the last Pen Enable (PE) command received (CRT beam on or off). PE can be overridden by Blank Memory (BM) or Blank File (BF) commands.
2. The Character Size (CS) command determines the size and orientation of text. When responding to a text command, the 1350A uses the last CS command received.
3. 1350A memory is made up of 2048 words. Each word may be either: (a) a vector endpoint coordinate pair (X,Y); or (b) an ASCII Text character.
4. 1350A memory can be partitioned into a maximum of 32 file areas. Each file can contain from one to 2048 words of memory. Total allocated file area must not exceed 1350A memory size of 2048 words.
5. Stop Naming (SN) command should follow the last vector or character entered into a file.
6. A file does not exist until named and data entered via PA or TX commands. (Note: All 2048 words in 1350A memory default to file zero when an EN (Erase Names) command is received.)
7. Following a command that requires a parameter a data field exists until delimited by a comma (,). This data field is of variable length. In the data field, only the last four characters will be used by the 1350A. If less than four digits are sent, the 1350A inserts leading zeroes. If more than four characters are placed in the data field (leading spaces for example), the 1350A will ignore all except the last four characters preceding the comma. Any characters in these last four positions will be treated as digits by the 1350A.

Example: "NFXXX...XXDDDD,;" X=don't care; D=ASCII digit

---

### NOTE

Data fields must contain integer values only in the last four positions preceding the comma. If computed values (for example TAN X) are done in floating point, be careful that only integer results are sent to the 1350A (truncate). No decimal point is allowed.

---

8. Following a PA command, the X and Y entries both follow the above rule. The X data field is delimited by a comma (,). The Y data field is delimited by a semicolon (;). The Y data field (preceeding the semicolon) follows the same rules as do the data fields that are delimited by a comma.

---

**NOTE**

Remember:

X = 0 thru 1022

Y = 0 thru 1023

with NO sign or decimal point.

---

## Required Initialization Sequence

Whenever the 1350A is powered on, or whenever a new program is to be sent to the 1350A, a specific initialization sequence is required. This sequence provides the proper starting point by "clearing out" the 1350A.

---

**NOTE**

For a 1350A equipped with HP-IB that has a serial number prefix of 1920A and below, the Initialization must start with an Interface Clear (IFC) message from HP-IB. This sets all devices on the bus to a quiescent state. The IFC message is used only with HP-IB on units of serial prefix 1920A and below. It is not necessary with newer units. Also, the IFC message has no meaning for other 1350A interfaces (such as RS-232).

---

The following items must be sent to the 1350A in the order given below. This insures that the 1350A will initialize properly after power-on (or an error).

[ETX][DC4]:EM:EN:EX:SN:SN:UM:

1. ETX      The ASCII End of Text character (3 in base 10) makes sure that the 1350A is taken out of a possible Text mode "wake up" condition. When in Text mode, the 1350A assumes that anything received is to be displayed as characters - including command terminators and control characters.
2. DC4      The ASCII DC4 character (20 in base 10) turns the POWER INTERRUPT indicator off. This allows the 1350A to warn the operator if a power disruption occurs that may affect operation. POWER INTERRUPT is automatically turned on whenever the 1350A is powered on. Thus it must be turned off during initialization in order to indicate any subsequent power disruption.

---

#### NOTE

On most terminals, the ETX character can be obtained by pressing the Control [CNTL] and capital C keys at the same time. The DC4 character can be obtained by pressing [CNTL] and capital T keys at the same time.

---

3. :      The colon is used as a <terminator> so that the 1350A will receive the next two characters as a two-letter command. ASCII CR or LF could replace the colon.
4. EM:      The EM commands the 1350A to erase its memory. This "cleans out" all vector and pen enable values that are present due to the random power up of memory. The colon provides the <terminator> for the EM command.
5. EN:      The EN commands the 1350A to erase all file names present due to random memory power up. Colon terminates EN command.
6. EX:      Erases all multiple display blanking information from 1350A memory after random power up. Colon terminates EX command.

- 7. SN: Stop Naming insures that no files are named until the 1350A is specifically instructed to do so. See the File Operations section of this chapter. Colon terminates SN command.
- 8. SX: Stop Auxiliary insures that no data is assigned to multiple display blanking combination(s) until the 1350A is specifically instructed to do so. Multiple display blanking is covered in Chapter 5 of this manual. Colon terminates SX command.
- 9. UM: Unblank Memory takes the 1350A out of a possible "wake-up" condition where the memory could be in a non-viewable (blanked) state. In essence this command sets the entire memory to a viewable state (unblanked). Colon terminates UM command.

The following commands are discussed in detail under the Initialization function: (a) EM, Erase Memory; (b) EN, Erase Names; (c) EX, Erase Auxiliary; (d) BM, Blank Memory; and (e) UM, Unblank Memory.

## Erase Memory Command

- a. Syntax. EM<terminator>
- b. Explanation.

Erase Memory erases all vector coordinate endpoints, text characters, and pen status (display beam on or off) from 1350A memory. This results in all 2048 words of memory containing vectors of zero length and pen status of "beam off." This command is normally used for initialization only.

Erase Memory also moves the Write Pointer to memory location zero. The Write Pointer is discussed in the WRITE POINTER section of this chapter.

---

### NOTE

Each word of the 2048-word memory may contain either a vector endpoint or a text character. This is defined as the data content. File, Pen Enable, Memory Blanking, and Auxiliary information are defined as status information. Each of the 2048 data words are accompanied by this status information.

---

## Erase Names Command

- a. Syntax.           EN<terminator>
- b. Explanation.

Erase Names erases all file names from 1350A memory. This results in all 2048 words of memory being assigned to file zero. Data contained in the 2048-word memory is not changed. Normally this instruction is used for initialization in order to clear out undesired file boundaries from memory.

## Erase Auxiliary Command

- a. Syntax.           EX<terminator>
- b. Explanation.

Erase Auxiliary removes all multiple display blanking information from 1350A memory. This results in all 2048 words of 1350A memory being assigned to the "unblank all rear-panel DISPLAY outputs (1-4)" combination. Data contained in the 2048-word memory is not changed. Normally this instruction is used for initialization only.

## Blank Memory Command

- a. Syntax.           BM<terminator>
- b. Explanation.

Blank Memory prevents the 1350A from displaying any information. The Pen status (beam on or off), File unblanking, and multiple display unblanking are overridden. Data (and status) in 2048-word memory are are not changed.

This instruction is normally used when sending data to the 1350A in a batch mode. Memory is blanked (display inhibited), data loaded, then memory is unblanked so that the picture can be seen instantaneously.



---

**NOTE**

The hierarchy of blanking in the 1350A provides several levels for controlling the status of the display beam (on or off).

1. Blank Memory turns the beam completely off.
  2. Blank File (BF) turns the beam off for all data in a particular file.
  3. Pen Enable (PE) turns the beam on and off to draw pictures when not overridden by BM or BF.
- 

## Unblank Memory Command

a. Syntax.           UM<terminator>

b. Explanation.

Unblank Memory is the complement of Blank Memory.

Unblank Memory allows the 1350A to display information according to Pen status, File blank/unblank, and multiple display (Auxiliary) instructions.

## Drawing Vectors

This section tells how to use the Plot Absolute (PA) and Pen Enable (PE) commands in order to “draw” vectors on a display.

### Display Area

The display area is defined by the limits of the X and Y values possible. The X axis range is from 0 to 1022. The Y axis range is from 0 to 1023.

The (0,0) point is at the bottom left-hand corner of the display. The (1022,1023) point is at the top right-hand corner. See figure 3-1.

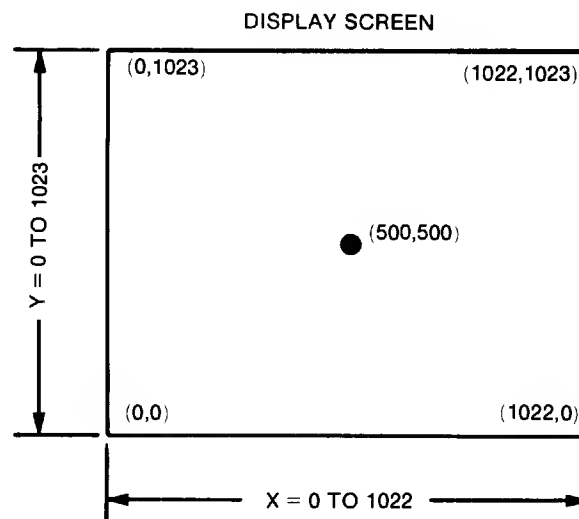


Figure 3-1. Vector Drawing Area as Defined by X and Y Values

All vectors are drawn in the display area according to the “vector endpoint” rule. This specifies that the X and Y values following a PA instruction determine the next beam location (endpoint) as an absolute value. For example, if X=1022 and Y=0 in a PA command (PA1022,0;) the beam will move to the bottom right-hand corner of the display, no matter what its previous location.

After an EM (Erase Memory) command has been received during Initialization, all 2048 words of 1350A memory contain the coordinate pair (0,0).

## Plot Absolute Command

### a. Syntax.

PA<abs X>[,]<abs Y>[:]<terminator>

<abs X> = 0 to 1022

<abs Y> = 0 to 1023

### b. Explanation.

The X and Y values determine the absolute location of the display beam (vector endpoint). Each X and Y coordinate pair occupies one location in 1350A 2048-word memory. Thus the 1350A is capable of causing up to 2048 vectors to be drawn on the display.

The display beam moves sequentially to each new coordinate point from the previous coordinate point in the order that the coordinate points (X,Y) are received by the 1350A.

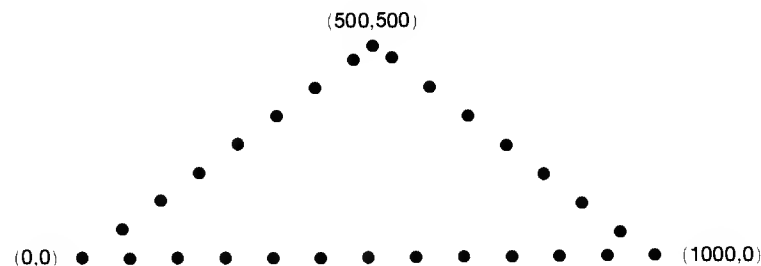
Several vector endpoints may be sent to the 1350A after a PA command by using the following syntax.

PA<absX>[,]<absY>[:]<absX>[,]<absY>[:] ... <absX>[,]<absY>[:];

For example, let's assume that the beam position is at the (0,0) coordinates and the ASCII string shown below is sent to the 1350A.

PA500,500;1000,0;0,0,;

The beam will move in a pattern that describes an isosceles triangle on the bottom half of the display as shown below.



## Pen Enable Command

### a. Syntax.

PE<enable>[,]<terminator>

<enable>=0 for beam off

<enable>=1 for beam on

### b. Explanation.

The PE parameter determines whether vector(s) are to be visible (display unblanked by PE1,: ) or invisible (display blanked by PE0,: ).

For a vector to be visible, the display must be set to "beam on" condition (unblanked).

The 1350A follows the last PE command received in order to determine whether a vector is to be visible or invisible on the display.

After an EM command has been received during Initialization, all 2048 words of 1350A memory are assigned Pen status of "beam off."

Even though a PE command specifies "beam on," it can be overridden by a Blank Memory (BM) or a Blank File (BF) command.

The blanking hierarchy is as follows:

1. Blank Memory turns the display beam completely off. Unblank Memory allows the picture to be shown according to file and pen unblanking.
2. Blank File overrides Pen Enable unblanking for all data in the file being blanked. Unblank File allows the data in the file (vectors and/or characters) to be shown according to Pen Enable unblanking.
3. Pen Enable turns the display beam on (unblank) and off (blank) in order to produce the picture.

## Vector Drawing Example

In the following example assume that the 1350A has been Initialized. All 2048 words in memory contain the vector coordinates (0,0) so that the beam is positioned in the bottom left-hand corner of the display. Also, all 2048 words have been assigned the Pen status of "beam off." The 1350A memory has been unblanked by the UM command so that the beam can be turned on and off by PE commands.

If we wish to "draw" two lines on the display as shown in figure 3-2a, the 1350A must receive the following ASCII string.

```
PE0,;PA200,300;;PE1,;PA800,300;;PE0,;PA800,700;;PE1,; PA200,700;;
```

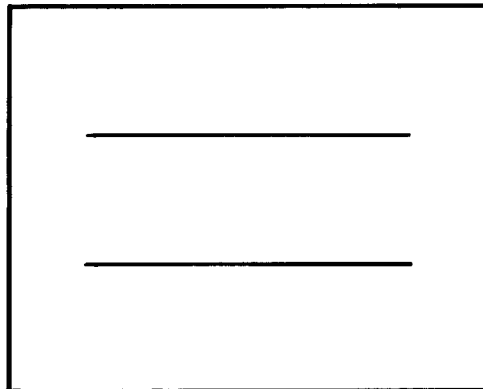


Figure 3-2a. Desired Example Display of Two Lines

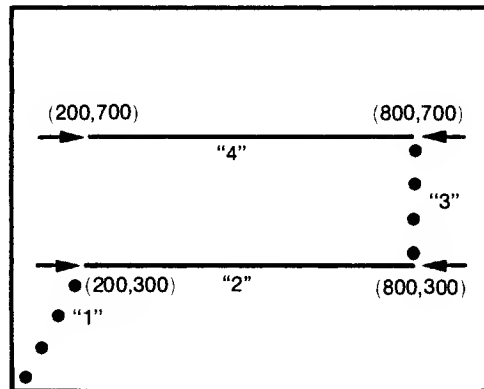
Let's break the "drawing" into the four vectors necessary to produce the display as shown in figure 3-2b.

---

**NOTE**

The vectors shown by "●" are those drawn with beam off.

---



**Figure 3-2b. Visible and Invisible Vectors Required to Draw the Picture Shown in Figure 3-2a**

Vector "1" is produced by the "PE0,;PA200,300,;" portion of the command string. The beam is turned off and moved to the X-Y coordinates of (200,300).

Vector "2" is produced by the "PE1,;PA800,300,;" portion of the command string. The beam is turned on and moved to location (800,300).

Vector "3" is produced by the "PE0,;PA800,700,;" portion of the command string. The beam is turned off and moved to location (800,700).

Vector "4" is produced by the "PE1,;PA200,700,;" portion of the command string. The beam is turned on and moved to location (200,700).

It is important to remember that each movement of the beam produces a vector, whether or not it is to be visible in the drawing.

## Drawing With Variables

In many applications it is desirable to "draw the picture" by using variables rather than fixed numbers.

When computations are used to produce the X and Y parameters for PA commands, make sure to use format statements that produce four-place fixed numbers (no decimal point).

Also, clipping should be performed on vector endpoints to insure that computed X and Y values are within their permissible ranges. (Note: X = 0 to 1022; Y = 0 to 1023 with no sign or decimal.)

## Displaying Text

This section explains how to use the Text (TX) and Character Size (CS) commands in order to display text.

For example, this feature allows the 1350A to label drawings or display program listings.

Each character to be displayed occupies one location in the 1350A 2048-word memory. This also includes space characters used in the text (32 in base 10 = space) and text mode control characters such as Carriage Return (CR) and Line Feed (LF).

## Preconditioning the 1350A for Text Mode

Before text mode is entered the following sequence should be used. This sets the 1350A up so that the desired text will be properly displayed.

1. Turn the display beam off (PE0;:).
2. Move the display beam to the desired starting point for the text (PAX,Y;:).  
(Note: Remember that this vector uses one word of the 1350A 2048-word memory.)
3. Turn the display beam on (PE1;:) so that subsequent text will be visible on the display.
4. Set the size and rotation for text via a Character Size (CS) command. The CS command is discussed on the following page.

## Character Size Command

### a. Syntax.

CS<size>[,]<terminator>

<u>&lt;SIZE&gt;</u>	<u>CHARACTER SIZE</u>	<u>ROTATION</u>	Character Area (in addressable points)		
			<u>WIDTH</u>	<u>HEIGHT</u>	
0	X 1	0 degrees	12	X	20
1	X 2	0 degrees	24	X	40
2	X 4	0 degrees	48	X	80
3	X 8	0 degrees	96	X	120
4	X 1	90 degrees CCW	12	X	20
5	X 2	90 degrees CCW	24	X	40
6	X 4	90 degrees CCW	48	X	80
7	X 8	90 degrees CCW	96	X	120

### b. Explanation

The CS command allows one of the four available sizes of text to be displayed. CS also allows text to be displayed either normally or else rotated 90 degrees counterclockwise (CCW).

When using the smallest size, 82 characters per line can be displayed. Since each character (both displayed and control, such as CR and LF) occupies one of the 2048 locations in 1350A memory, be careful in considering how many lines of text to display at one time.

If the smallest size is being used, for example, make sure to send a CR and an LF after each 82nd character to position the display beam for the next line of text. Remember to include both the CR and LF characters in the total when determining how many words of 1350A memory are being used.



Spacing between characters and lines is provided automatically by the 1350A to facilitate readability. This spacing is a function of the character size selected. The area for each character is equal to approximately 1.66 times the height and 1.5 times the width of the character. This "open area" is provided above and to the right of each character for spacing between characters and lines. Character area is diagrammed in figure 3-3 using a capital "T" character.

The automatic spacing causes each character to end at the starting point for the next character. This advancement of the beam causes the 1350A to function much like a typewriter.

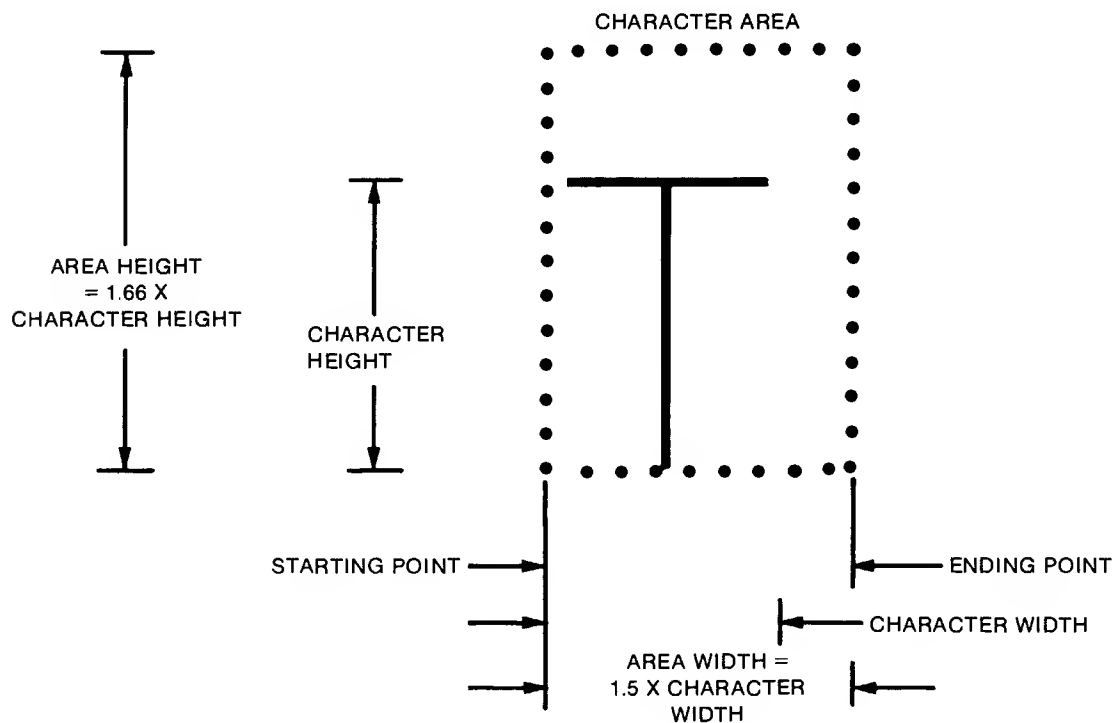


Figure 3-3. Automatic Spacing Provided by Character Area

For non-rotated text, the starting point for each character is the lower left-hand corner of the character area. For rotated text, the entire character is rotated 90 degrees CCW about this point. When displaying text near the edge of the allowable display area be careful that the display beam position will not cause part of the text to be unreadable.

The characters can all pile up on top of one another when the display beam is not properly positioned via either Plot Absolute (outside of text mode) or text mode control characters (when in text mode).

---

#### NOTE

Remember that the 1350A always uses the last CS command received when setting size and rotation of text to be displayed.

---

## Text Command

### a. Syntax.

TX<string>[end text]<terminator>

### b. Explanation.

A Text (TX) command allows the 1350A to provide characters on the display without the programmer having to draw all the vectors necessary to produce each character.

The 1350A modified ASCII character set is listed in an appendix at the end of this manual.

The 1350A follows the last CS command received when displaying text (size and rotation).

Text mode is exited when the 1350A receives an ASCII ETX character (End of Text = 3 in base 10). After the ETX the 1350A must receive a command terminator (colon, CR, or LF) to end the Text command.

Everything between the TX command and the ETX is treated as text to be displayed (or text control characters such as CR or LF).

## Text Mode Control Characters

The text mode control characters listed in table 3-4 are used to position the display beam while the 1350A is in text mode.

Table 3-4. Text Mode Control Characters

DECIMAL VALUE	OCTAL VALUE	DEFINITION
8	010	Backspace (BS). Moves beam back one character area. Amount of movement is set by size of text.
9	011	Inverse Line Feed. Moves beam up one character area. Amount of movement is set by size of text.
10	012	Line Feed (LF). Moves beam down one character area. Amount of movement is set by size of text.
13	013	Carriage Return (CR). Moves beam to left-hand edge of display.

## Text Mode Special Plotting Characters

Table 3-5 lists special plotting characters that do not automatically advance the beam to the starting point or the next character. The beam is left at the center of the character.

These characters provide a means whereby lines on a graph can be differentiated to aid readability. (Note: See Example 4 in Chapter 6.)

Table 3-5. Text Mode Special Plotting Characters

DECIMAL VALUE	OCTAL VALUE	CHARACTER
11	013	Vertical Tick Mark (   )
12	014	Horizontal Tick Mark ( — )
14	016	X marker symbol
15	017	Rectangle symbol
30	036	Diamond symbol

A line can be drawn by either having the special characters connected (beam on between data points) or having them unconnected (beam off between data points).

More than one special character may be placed at each data point, thus increasing the possible number of line types.

The general method when using special plotting characters is:

1. Set the size and rotation for the special plotting characters with a Character Size (CS) command.
2. Turn the display beam on or off, as desired, so that the data points will be either connected or unconnected. This is done with the Pen Enable (PE) command.
3. Move the beam to the data point with a Plot Absolute (PA) command.
4. Mark the data point with the desired special character(s) via a Text (TX) command. Remember to first turn the beam back on if it was off while the beam was being moved.
5. End text mode with an ETX character followed by a command terminator.
6. Repeat steps b through e for each data point on the line.

## Text Display Example With Starting Point Calculation

The following ASCII string will cause the 1350A to display the text "1350A" on the center of the display. It is assumed that the 1350A has been Initialized.

```
PE0,;PA390,440,;PE1,;CS2,;TX1350A ETX;
```

The "PE0,;" turns the display beam off. The "PA390,440,;" moves the display beam to the starting point for the text. "PE1,;" turns the display beam on. "CS2,;" sets character size and rotation for the text. "TX1350A" commands text mode and specifies characters to be displayed (1350A).

How was the starting point determined? The center point of the display area is 510,510. The area for each character is 48 X 80 addressable points (CS2,;).

For the X-axis starting point:

5 characters (1350A) divided by two is 2.5 character areas; multiply 2.5 character areas by 48 points per character to get 120 addressable points; subtract 120 from 510 to get the X starting point of 390.

For the Y-axis starting point:

divide the 80 points per character by two for 40 addressable points; subtract 40 from 510 to get the Y starting point of 470.

## Write Pointer

The 1350A Write Pointer specifies the word number of the next location in 1350A memory where a vector endpoint (or text character) will be placed. Each endpoint (or character) is accompanied by the current status information (Pen, File, etc.).

---

### NOTE

The 1350A has a modulo 2048 word memory. The 2048 words are numbered 0 to 2047. If memory size is exceeded, then a wrap-around will occur. For example, location 2048 wraps around and will over-write the contents of memory word zero.

---

The Write Pointer advances sequentially through memory unless jumped to a different value by the commands:

- (1) Erase Memory, EM
- (2) Erase File, EF
- (3) Find File, FF
- (4) Find Location, FL.

The Write Pointer is moved to location zero as a result of either an EM or an EF command.

The FF command moves the Write Pointer to the first word in the file specified.

The FL command moves the Write Pointer to any location in memory (regardless of whether files are being used or not).

Therefore the Write Pointer can function as a moveable cursor for placing information into 1350A memory. Since the Write Pointer will automatically advance one word at a time, the programmer is given the choice of either using or not using the mobility of the Write Pointer.

## File Operations

This section explains how to create and manipulate files in the 1350A memory.

Each word in the 2048-word 1350A memory may be either a vector endpoint (X,Y) or a text character.

A 1350A file is defined as a collection of memory words treated as a unit.

The 1350A memory may be sectioned into as many as 32 files. Each file can be made up of from one to 2048 words of memory. The total number of words in all files must not exceed 2048. Each file must contain at least one word.

All vectors and/or characters that have been grouped together as a file can be manipulated as one unit via 1350A file management commands.

Each file is individually addressable and can be blanked, unblanked, erased, or rewritten. This allows each group of data to be flashed on and off the display or rapidly updated.

File manipulation allows graphs to be quickly updated and compared, mechanical drawings to be "built up" or "stripteased," three-dimensional "rotating" drawings to be created, or "animated" drawings to be produced.

The following commands are discussed in detail in this section: (a) NF, Name File; (b) SN, Stop Naming; (c) FF, Find File; (d) FL, Find Location; (e) BF, Blank File; (f) UF, Unblank File; and (g) EF, Erase File.

## Creating Files

During Initialization the EN (Erase Names) command removes all file boundaries. All 2048 words in 1350A memory are assigned to file zero.

Each desired file can now be created by placing all vectors and/or characters for each file between the Name File (NF) and Stop Naming (SN) commands.

Although all words in a file do not necessarily have to be grouped together in order to function as a unit, we recommend that all data in a file be contiguous. If not grouped together sequentially in memory, then the exact location of each word in the file must be known in order to change or update the file.

## Name File Command

a. Syntax.

NF<file>[,]<terminator>

<file>=0 to 31

b. Explanation.

Name File (NF) assigns each following vector endpoint (PAX,Y;,) or text character to the file specified by the <file> parameter.

Pen status (display beam on or off), and character size information (for text), automatically accompanies each vector and/or character placed in a file.

Each word in the file is written to 1350A memory starting at the current value of the 1350A memory Write Pointer.

After all desired words are placed in a file the naming process should be delimited (ended) via a Stop Naming (SN) command.

## Stop Naming Command

### a. Syntax.

SN<terminator>

### b. Explanation.

The Stop Naming (SN) command tells the 1350A to quit assigning memory words to the last file named. This "closes" the current file.

It is possible for information to be lost if SN is not used properly.

Example:

The information in memory words 0003 and 0004 (part of file 1) and words 0005 thru 0007 (part of file 2) needs to be changed.

The Write Pointer is currently at word 0016 (in file 3; a "NF3,;" command has been sent and data is being assigned to file 3).

A "FL3,;" command is sent to the 1350A, moving the Write Pointer to word 0003.

A Stop Naming ("SN:") command was not sent before moving the Write Pointer.

Information in words 0003 thru 0007 is changed (with PA and/or TX commands).



Since file 3 was not "closed," words 0003 thru 0007 are now in file 3. Part of files 1 and 2 are now missing. See figure 3-4.

Considerable work would have to be done with FL, NF, and SN in order to restore the memory to proper order.

BEFORE		AFTER	
MEMORY WORD	FILE NAME	MEMORY WORD	FILE NAME
0	1	0	1
1	1	1	1
2	1	2	1
3	1	3	3
4	1	4	3
5	2	5	3
6	2	6	3
7	2	7	3
8	2	8	2
9	2	9	2
10	3	10	3
11	3	11	3
12	3	12	3
13	3	13	3
14	3	14	3
15	3	15	3
16			

Figure 3-4. Example of SN Command NOT Being Used Properly

## Find Location Command

### a. Syntax.

FL<location>[,<terminator>]

<location> = 0 to 2047

### b. Explanation.

Find Location (FL) moves the 1350A memory Write Pointer to the word number specified. The next word written into 1350A memory (vector endpoint or text character) is placed in the location specified by the FL parameter.

---

#### NOTE

The Write Pointer now returns to its normal mode whereby it automatically advances to the next memory location. Each vector endpoint (or text character) received will cause the Write Pointer to increment to the next higher memory word number (location). Example: If an FL1500,; command is used and a vector endpoint (or text character) is written into memory word 1500 (by a PA or TX command), then the Write Pointer value becomes 1501. The next endpoint (or character) received is automatically placed into location 1501 and the Write Pointer increments to 1502.

---

After power-on, the Write Pointer could be anywhere. If 1350A files are to be used it is good practice to first move the Write Pointer to memory word zero (FL0,;) before naming the first file. The Erase Memory command also positions the Write Pointer to word zero.

After data has been placed in a file, FL can be used to selectively change individual words in the file as long as the word number(s) of the item(s) to be changed are known. This can be accomplished fairly easily if the 1350A memory has been sectioned into fixed-length files.

## Fixed Length Files

Before meaningful data is placed in 1350A memory, the memory can first be "sectioned" into files of known length and boundaries.

In order to mark fixed-length files in 1350A memory, use the following sequence.

1. Initialize the 1350A.
2. Move the Write Pointer to memory word zero with a Find Location command (FL0,:).
3. Set up a program loop for the desired number of files (FOR...NEXT or DO, for example).
4. Name each file with a Name File (NF) command on each pass through the above loop.
5. Set up a program loop that is internal to the above loop. Use this loop to assign the desired number of words to each file.
6. Send the 1350A a "dummy vector" on each pass through the internal loop. The "dummy vector" (PE0,:PA0,0,:) provides each word in the file with a required content so that the file truly exists and can be later addressed.
7. Send the 1350A a Stop Naming (SN,:) command after the internal loop has completed all its iterations. This terminates the naming process before the outer loop increments to start naming the next file.

Example.

The following is a general example using FOR...NEXT loops.

- a. Send the 1350A its Initialization sequence.
- b. Send the 1350A the ASCII string "FL0,:".
- c. FOR A=1 TO 3

- d. Send the 1350A NF A followed by ASCII “,” and “:” (or CR/LF).
- e. FOR N=1 TO 500
- f. Send the 1350A the ASCII string PE0,PA0,0;
- g. NEXT N
- h. Send the 1350A the ASCII string SN:
- i. NEXT A
- j. END

The above example causes four files to be created in the 1350A memory. Files “1”, “2”, and “3” will each have 500 words allocated. Since the 1350A was Initialized at the start, the remainder of memory defaults to file “0”.

File “1”:	memory words	0-499.
File “2”:	memory words	500-999.
File “3”:	memory words	1000-1499.
File “0”:	memory words	1500-2047.

The Find File (FF) command can now be used to place meaningful data in each file.

## Find File Command

- a. Syntax.

FF<file>[,<terminator>

<file> = 0 to 31

- b. Explanation.

Find File (FF) moves the Write Pointer to the first memory word in the file specified. The file specified by the parameter must have been previously named by a NF....SN sequence and must have contents (“dummy vectors” or real data).

---

**NOTE**

If an FF command is executed for a non-existent file the 1350A never acknowledges that the instruction was completed and the I/O will time out. See Chapter 4 for System Time Out Considerations.

---

The FF command may be used to place data in a file for the first time by positioning the Write Pointer so that the "dummy vectors" in a fixed-length file can be over-written by Plot Absolute (PA) and Text (TX) commands.

The FF command may also be used when the entire contents of an existing data file are to be changed.

Memory words remain sequential from 0 to 2047 regardless of the file to which they are assigned.

The FF command (and FL command) may thus be used both in the creation and updating of files. Updating files is one of the functions that falls under the File Manipulation category.

## Manipulating Files

Previously created files (named and having contents) can be manipulated to enhance the pictures presented by the 1350A.

The commands used to manipulate 1350A files are: (a) BF, Blank File; (b) UF, Unblank File; (c) EF, Erase File; (d) FF, Find File; and (e) FL, Find Location.

All data contained in a file can be blanked (turned off) or unblanked (turned on) at one time. This selective display/no display feature allows the effect of motion to be simulated by using an animation technique. It also allows quick comparisons of different data to be presented for easier interpretation, or data of interest to be flashed on and off the display (Blank, wait, Unblank, wait loop).

Each file can have all its data contents erased and/or rewritten. Also, selective data within a file can be rewritten. This allows rapid updating of information to display new results.

## Blank File Command

### a. Syntax.

BF<file>[,]<terminator>

<file> = 0 to 31

### b. Explanation.

Blank File (BF) prevents any information contained in the file specified from being displayed. The file specified by the parameter must have already been named (NF....SN sequence) and have contents.

Blank File overrides all Pen Enable commands contained as status information for vectors and characters in the file specified. Data in the file specified is not changed.

## Unblank File Command

### a. Syntax.

UF<file>[,]<terminator>

<file> = 0 to 31

### b. Explanation.

Unblank File (UF) allows vectors and/or characters contained in the file specified to be displayed according to the Pen Enable status (display beam on or off) of the vectors and/or characters.

The file specified by the parameter must have already been named (NF....SN sequence) and have contents.

After the Initialization sequence the 1350A is in the “unblank all files” configuration. When files are subsequently created they are unblanked until the 1350A is specifically told to blank a file by a BF command.

## Erase File Command

### a. Syntax.

EF<file>[,]<terminator>

<file> = 0 to 31

### b. Explanation.

Erase File (EF) causes all memory words in the file specified to be rewritten with "dummy vectors" (PE0;PA0,0;). The "dummy vectors" provide contents so that the file remains addressable. The number and location of words in the file remain unchanged.

EF moves the Write Pointer to memory word zero after the data in the file specified has been replaced by "dummy vectors." Therefore, the Write Pointer must be moved by either a Find File (FF) or a Find Location (FL) command before entering new vectors and/or characters. If not moved, the Write Pointer causes each new vector or character to be placed sequentially into memory starting at word zero. This will cause data in these locations to be over-written and thus lost.

The file specified by the parameter must have already been named (NF....SN sequence) and have contents.

## Updating Files

Data in files may be changed by using the Find File (FF) and Find Location (FL) commands.

If all data in a file is to be changed we recommend that the FF command be used. It is optional to use the EF command first, but provides good housekeeping to do so.

Example:

Assume a fixed-length file of 500 words, with the first 300 words containing a picture and the last 200 words blank.

If you want to redefine the file to a picture that only uses the first 200 words, and do not first erase the file, then the last 100 lines of the old picture will still be left in the file.

If memory word(s) other than the first word(s) in a file must be changed, use the FL command to move the Write Pointer to the specific word(s) to be changed. FL can be used to change a range of words within a file by moving the Write Pointer to the first word of the list to be changed, for example.

Data in a file is changed (after first positioning the Write Pointer) by sending the 1350A new vector endpoints (Plot Absolute command, PA) or new text characters (Text command, TX). Each vector endpoint (or character) should be preceded by the appropriate Pen Enable (PE) command (display beam on or off). New text characters should also be preceded by the appropriate Character Size (CS) command.





# Chapter 4

## Hardware

### Introduction

This chapter will cover 1350A hardware as it pertains to the operator (programmer). A simple block diagram will be used to show basically how the 1350A works. Memory maps are then discussed to aid the operator understand the “whys” of programming considerations. The 1350A must refresh the display periodically so that the picture doesn’t fade out. Refresh rates and their programming implications are given. Finally, 1350A Line Sync and Point Blanking switches are explained.

### Block Diagram Description

Figure 4-1 shows a simplified block diagram of the 1350A hardware.

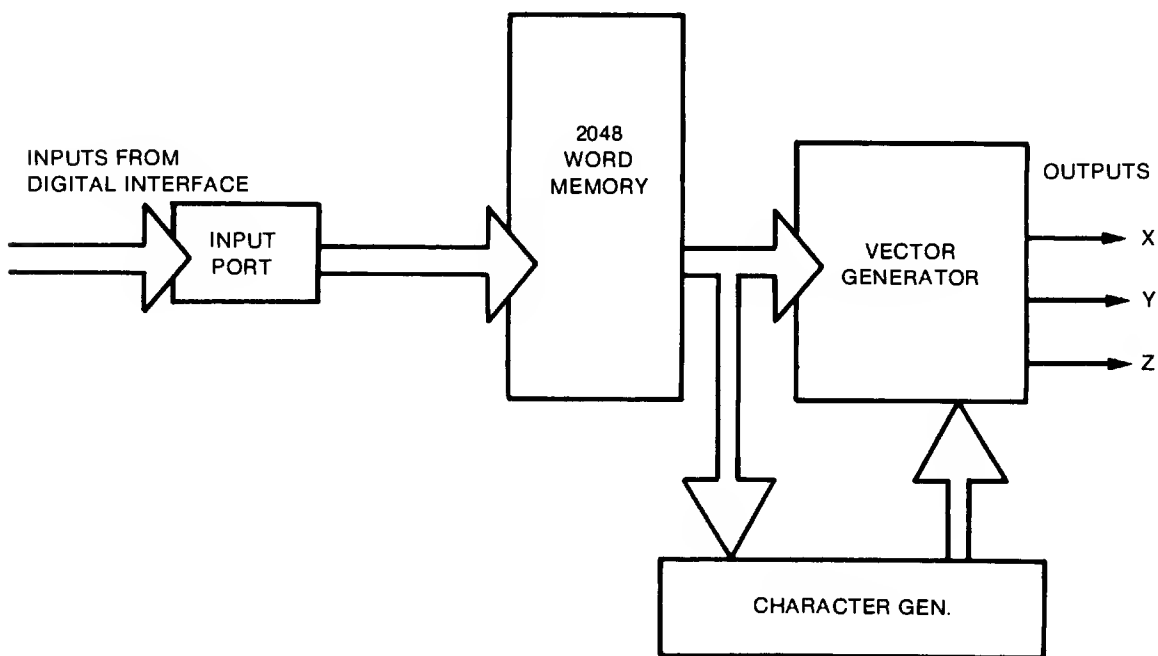


Figure 4-1. 1350A Simplified Block Diagram

Memory is the heart of the 1350A. Digital information from the memory produces the X, Y, and Z analog signals that "draw" pictures on the display.

Information from the digital interface (programming commands) causes the desired picture-producing data to be written into the 2048-word 1350A memory.

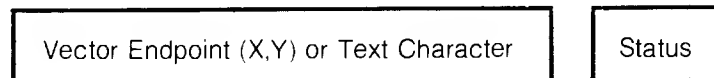
As each vector or character (plus status information) is written into a memory word, an internal device called the Write Pointer is automatically incremented one count. The Write Pointer value is the memory word number (0-2047) where the next vector or character that is received from the digital interface will be stored. The Write Pointer can be moved around by the programmer as discussed in Chapter 3.

The 1350A automatically outputs the 2048 words of memory in repetitive cycles. As each word in turn is addressed, it outputs its contents. If the word contains vector endpoint coordinates (X,Y) then the data is sent directly from memory to the Vector Generator. If the word contains a text character then the Character Generator takes over the Vector Generator and produces all the vectors necessary to form the character.

The continuous outputting of information is called "Reading" the memory. After location 2047 has been "Read," location zero is addressed and the cycle begins again.

## Memory Map

Each word of the 2048-word memory is formatted as shown below.



The vector endpoint is made up of absolute X and Y values. It indicates the position where the beam will move next. The code for a text character causes the Character Generator to produce all vectors that form the character.

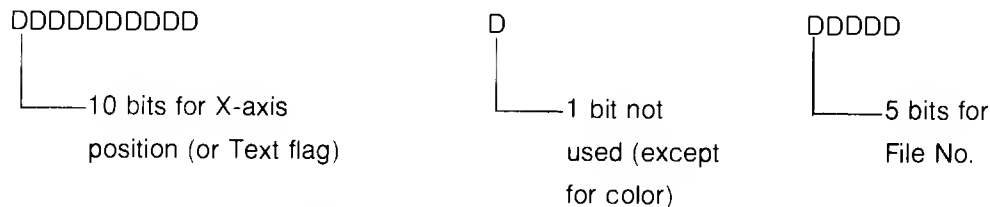
Status information that accompanies each of the 2048 words consists of:

1. Pen Enable (display beam on or off).
2. File name to which the word is assigned.
3. State of the file in which the word resides (blanked or unblanked).
4. Multiple display on/off combination.
5. If the word is a text character it is also accompanied by size and rotation information.

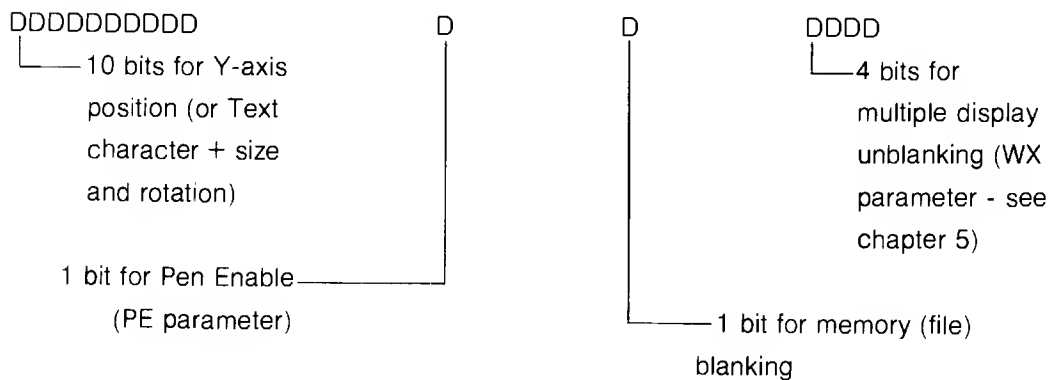
## Memory Word Composition

Each word is 32 bits wide. The 32 bits are separated into two 16-bit bytes.

- a. The first 16-bit byte contains:



- b. The second 16-bit byte contains:



When a word is written into memory as a result of either a Plot Absolute (PA) or a Text (TX) command, it is automatically accompanied by the status information. All status commands should have been previously received by the 1350A in order to produce the desired results. See Chapter 3 of this manual for programming rules.

Examples.

1. Memory contents for a vector endpoint of 256,67 (PA256,67,;) that is in file 15 (NF15,;), which is to be visible (PE1,;), with memory and file unblanked (UM: of UF15,;), and only display "3" unblanked (WX11,;).

a. First byte:	0100000000	0	01111
b. Second byte:	0001000011	1	1 1011

2. Memory contents for the text character "a" (TXa ETX,;) that is in file 2 (NF2,;), which is to be visible (PE1,;), with memory and file unblanked (UM: or UF2,;), and all displays (1-4) unblanked (WX0,;). Also, the small "a" character is to be the smallest size available and rotated 90 degrees CCW (CS4,;).

---

#### NOTE

The Text flag is set internally by the 1350A when placed in the text mode by a TX command. The Text flag (a value of 1023) is placed in the X area of the first byte. The second byte contains size and rotation plus the ASCII code for the character in the Y area. The Text flag automatically preceeds each character until the Text mode is exited (ETX character) and the TX command then terminated by a colon (or CR or LF).

---

a. First byte:	1111111111	0	00010
b. Second byte:	1001100001	1	1 0000

---

**NOTE**

Character size and rotation are placed in the three Most Significant Bits (MSBs) of the Y area. The ASCII code for the character is placed in the seven Least Significant Bits (LSBs). The "a" is 97 (decimal) which is 1100001 in binary. The Text flag (1023) is 1111111111 in binary.

---

Let's take a further look at the status bits in the first byte to see how the 1350A determines the color of data displayed by an HP Model 1338A Tri-color Display (see Chapter 5).

First byte:            DDDDDDDDDD            D1            DDDDD

These two file name bits —————

determine color according

to the following table.

File Name	D1	D	Color
0- 15	0	0	Green
16 - 31	0	1	Yellow
32 - 47	1	0	Red
48 - 63	1	1	Yellow

Files 48 thru 63 should not be used because they will over-write data contained in files 0 thru 15. Also, files 32 thru 39 will over-write data in files 0 thru 7 and files 40 thru 47 will over-write data in files 8 thru 15. This is why file names are restricted in color applications (Chapter 5). The table below shows proper file name usage to meet these restrictions.

File (NF command parameters)	Name Color of Data
0 thru 7	GREEN
16 thru 31	YELLOW
40 thru 47	RED

Figure 4-2 below shows a map of the 2048-word memory sectioned into four files (1 thru 4) of 512 words per file. Each word of memory is designated by [Data + S] to indicate that it contains both Vector Endpoint (or Text Character) + Status Information.

MEMORY WORD (ADDRESS)	CONTENTS	FILE NO. -----
0	[Data + S]	
1	[Data + S]	
2	[Data + S]	
3	[Data + S]	
.	.	1
.	.	
509	[Data + S]	
510	[Data + S]	
511	[Data + S]	-----
512	[Data + S]	
513	[Data + S]	
514	[Data + S]	
.	.	2
.	.	
1021	[Data + S]	
1022	[Data + S]	
1023	[Data + S]	-----
1024	[Data + S]	
1025	[Data + S]	
1026	[Data + S]	
.	.	3
.	.	
1533	[Data + S]	
1534	[Data + S]	
1535	[Data + S]	-----
1536	[Data + S]	
1537	[Data + S]	
1538	[Data + S]	
.	.	4
.	.	
2045	[Data + S]	
2046	[Data + S]	
2047	[Data + S]	-----

Figure 4-2. 1350A Memory Map for Four Files (1 thru 4) of 512 Words Each

## Status Register

Status commands are kept in a register so that they will be available whenever a vector endpoint (or text character) is written into memory.

Thus each status command establishes a condition (pen, file, character size, blanking, etc.) that remains in effect until changed by a subsequent status instruction.

Figure 4-3 shows a programming diagram of the Status Register.

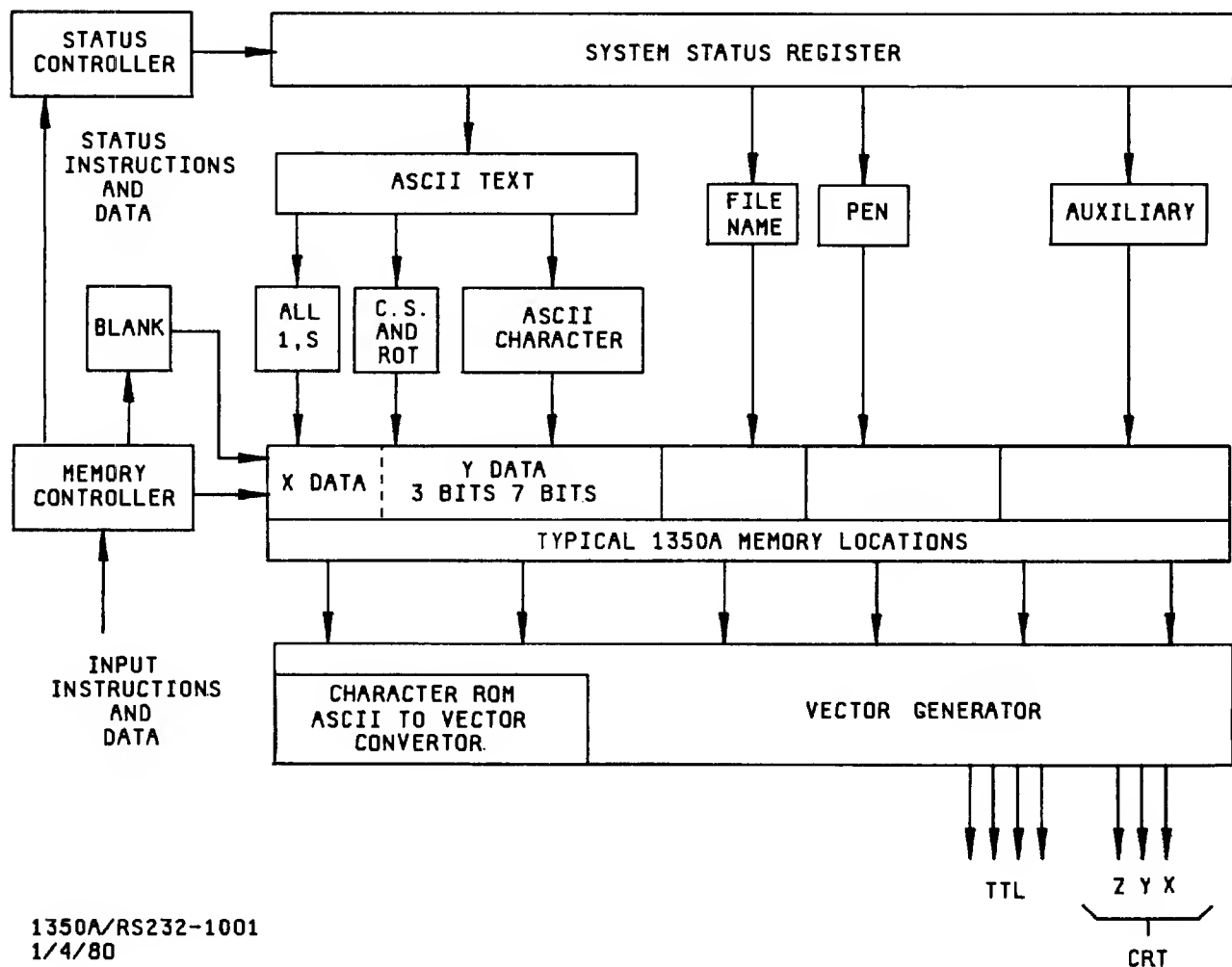


Figure 4-3. Programming Diagram of the Status Register



## Refresh Rate

The 1350A produces a viewable picture by periodically “repainting” the picture on the display. This “repainting” is called refreshing the display. How often the 1350A refreshes the display is a function of how long it takes for the memory to output (Read) the data from all 2048 locations. Each complete “Reading” of memory will “paint” the picture one time, and then the cycle repeats.

Each vector in the picture will require a time interval proportional to its length. The next memory word will not be addressed until the vector (or character) from the previous word has been completed. This causes the memory cycle time, and thus the refresh rate of the display, to be variable according to the picture being presented.

The absolute minimum time required for the 1350A to cycle through its 2048-word memory (“Read” all locations) is approximately 3.33 milliseconds (ms). The reciprocal of 3.33 ms is 300 Hz (Hertz = cycles per second). This means that at its fastest, the 1350A can “repaint” (refresh) the display 300 times every second.

The memory cycle time can increase to the point where the light output of the display phosphor will expire before the picture gets repainted. This produces visible “flickering” of the picture. The use of many long vectors in a picture will slow the 1350A down. The slower the 1350A, the more the display “flickers.” A typical phosphor display screen starts to flicker when refreshed at the rate of 30 to 50 times per second (Hertz).

## Refresh Time Calculation

Table 4-1 lists typical drawing times for characters and vectors. To determine 1350A refresh time (memory cycle time), total the drawing times for all characters and vectors in the picture. Then use the formula  $[(2048-N) \times 1.5 \mu s] + A \mu s = T$  where N = number of locations used, A = total drawing time of all vectors and characters in microseconds (us), and T = refresh time in microseconds.

Table 4-1. Typical Drawing Times for Vectors and Characters

---

Average Character .....	15 $\mu$ s (microseconds)
Vectors:	
1/2 or greater screen diameter.....	48 $\mu$ s
1/4 to 1/2 screen diameter.....	24 $\mu$ s
1/8 to 1/4 screen diameter.....	12 $\mu$ s
1/16 to 1/8 screen diameter.....	6 $\mu$ s
1/32 to 1/16 screen diameter .....	3 $\mu$ s
1/64 to 1/32 screen diameter .....	1.5 $\mu$ s

---

Example:

A display picture contains: 50 characters; a graticule of 20 vertical and 20 horizontal lines; 30 tick marks on graticule lines; and 200 data points joined by short vectors.

Refresh time calculation:

50 characters X 15 $\mu$ s (microseconds)	= 750 $\mu$ s
40 graticule vectors X 48 $\mu$ s	= 1,920 $\mu$ s
(30 + 200) short vectors X 1.5 $\mu$ s	= 345 $\mu$ s

Total = A = 3,015  $\mu$ s

N = 50 + 40 + 30 + 200 = 320 memory locations used

T = [(2048-320) X 1.5  $\mu$ s] + 3015  $\mu$ s

T = 2592  $\mu$ s + 3015  $\mu$ s

T = 5607  $\mu$ s = 5.6 milliseconds (approximately)

## Reducing Display Flicker

Sometimes it can take the 1350A so long to “paint” the picture that the display will not be refreshed often enough and flicker becomes a problem.

In some applications the 1350A can be made to refresh the display more often in order to reduce the flickering.

We recommend that you presort and group the data for minimum beam movement when drawing the picture. This reduces time spent “travelling back and forth” and optimizes the display.

An invisible vector requires the same amount of drawing time, and thus has the same effect on refresh rate, as does a visible vector. Therefore, you should try to minimize travel distance between visible vectors in order to decrease “flickering.”

Example:

To produce two visible lines on the display, you can use either method (a) or method (b) shown in figure 4. Method (b) should be used when flicker is a problem because the drawing time for vector “3” is shorter. This is a simplified example, but the saved time adds up as the number of vectors increases.

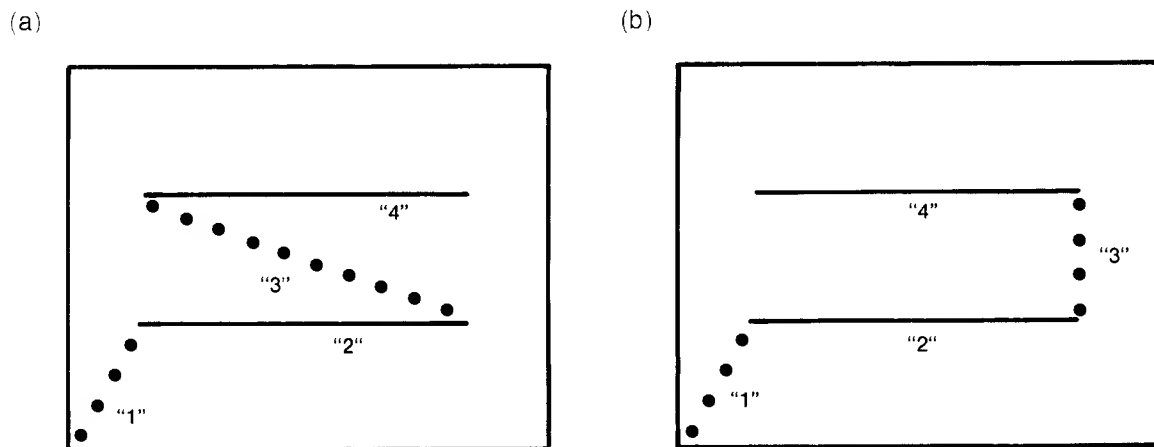


Figure 4-4. Method (b) Aids in Reducing Display Flicker Because Vector “3” Takes Less Time

## Line Sync

For systems having severe ground loop problems (or environments with strong magnetic fields) the 1350A may be synchronized to the frequency of the ac power line. This is done with the rear-panel LINE SYNC switch. Switch position nearest the fan is OFF.

Line sync should be used only when absolutely necessary. When line sync is used the display refresh rate may be reduced to the point where flicker becomes objectionable.

## Point Blanking

The Point Blanking switch allows the X-Y display to be blanked during the time interval between vectors. This is useful when a slow X-Y display is used.

The switch is set to the unblank (off) position at the factory. When an HP Model 1338A Tri-color Display is used, the switch should be set to the blank (on) position, which is rearmost.

Have qualified service personnel refer to Section III in the 1350A Operating and Service manual when this switch is to be repositioned.

---

### NOTE

The 1350A can have a problem when LINE SYNC is on and memory location 2047 contains data. This problem manifests as either a bright dot on the display screen or the data in location 2047 not being displayed. To solve this problem, do one of the following:

1. Turn LINE SYNC switch off, if possible.
  2. If you must run with LINE SYNC on, turn POINT BLANKING switch on.
  3. If you cannot do either of the above, then leave location 2047 blank (beam up).
-

## Configuring the 1350A to Listen Properly on the Digital Interface

Refer to the appropriate service documentation. For example, the main 1350A Operating and Service manual contains information on how to change the address when the 1350A is equipped with the HP-IB (Hewlett Packard Interface Bus) digital interface. When the 1350A is equipped with the RS-232C digital interface (Option 001) then the information is contained in the service document for Option 001.

When HP-IB is used, be careful not to exceed the cable length as specified in the standard (IEEE Std. 488-1978). Maximum HP-IB cable length is 2 meters times the number of devices on the bus, or 20 meters, whichever is LESS.

### System Time Out Considerations

Many systems provide the capability of setting a limit to the time allowed for an instruction to be completed. This allows the system to recover from errors or problems that cause the I/O bus to "hang up."

Since some 1350A commands take longer than others, we recommend that the minimum time out be 100 milliseconds. In practice, one or two seconds is not inappropriate.

Example:

If the 1350A is told to find a non-existent file (FF command) then it cannot respond that the command was completed. The I/O bus will "hang up." This will cause a time out to occur.

---

#### NOTE

A simple output buffering scheme may not check for time outs. If the I/O bus "hangs up," make sure that all files addressed by FF (Find File) commands do exist. A file only exists when it has been named and has contents.

---

# Chapter 5

## Extras

### Introduction

This chapter explains the programming considerations necessary when using the ancillary functions of the 1350A. These functions are: (a) simultaneous presentation of separate pictures on up to four different displays; (b) picture blinking through hardware; and (c) color display control.

### Multiple Picture Displays

This section describes how to use the Write Auxiliary (WX) and Stop Auxiliary (SX) commands to display several different pictures at the same time.

In order to display four different pictures at once four X-Y displays are required.

To produce four separate pictures, the 1350A must:

1. Turn one display on and the other three off.
2. Output vector and/or character (picture) information to the active display.
3. Turn the next display on and the other three off.
4. Output picture information to the active display.
5. Repeat steps c and d for the next two displays.

This cycle of “turn a display on and send out a picture, turn the next display on and send out another picture” provides the effect of different pictures being presented simultaneously (see figure 5-1).

Other combinations are possible, such as having the same picture on displays “1” and “2” while displays “3” and “4” each have their own pictures. First turn displays “1” and “2” on (“3” and “4” off) and send them a picture. Then turn on display “3” only and send its picture. Repeat for display “4”.

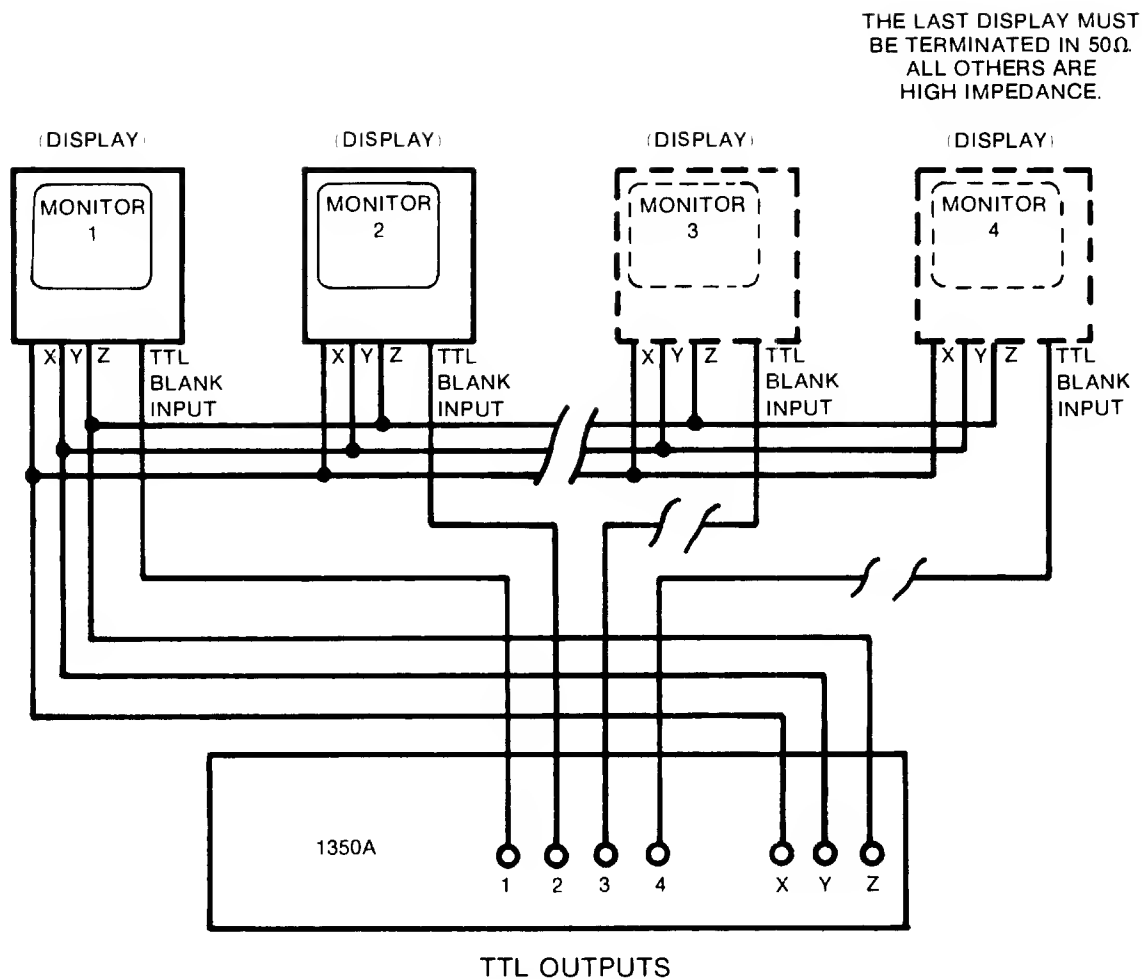


Figure 5-1. 1350A/Display Interconnections

With four displays there are 16 possible combinations available for determining which displays are on (and which are off) when the 1350A is sending out a picture (see table 5-1).

Multiple displays are turned on and off via the 1350A rear-panel "DISPLAY 1 thru 4" outputs. These outputs must be connected to the "TTL BLANKING" inputs (positive-going) on the displays. Refer to Section II in the Model 1350A Operating and Service manual and consult qualified service personnel when setting up a multiple display system.

The Write Auxiliary (WX) command determines the specific combination of which displays are on and which are off when the 1350A is sending out a picture. Each combination must be bracketed by a WX and an SX (Stop Auxiliary) set of commands.

## Write Auxiliary Command

### a. Syntax.

WX <display>[,]<terminator>

<display>=0 to 15

### b. Explanation.

Write Auxiliary (WX) sets the combination of which displays are turned on (unblanked) and which are turned off (blanked) when the 1350A is outputting vector and/or character information.

Each specific display blank/unblank combination is set by the WX parameter. Table 5-1 lists the blank/unblank combinations for all WX parameters.

**Table 5-1. WX Display Blank/Unblank Combinations**

WX PARAMETER DISPLAY	DISPLAY			
	1	2	3	4
0	U	U	U	U
1	B	U	U	U
2	U	B	U	U
3	B	B	U	U
4	U	U	B	U
5	B	U	B	U
6	U	B	B	U
7	B	B	B	U
8	U	U	U	B
9	B	U	U	B
10	U	B	U	B
11	B	B	U	B
12	U	U	B	B
13	B	U	B	B
14	U	B	B	B
15	B	B	B	B

U = Unblank (display on). B = Blank (display off).

The picture that is sent to a specific blank/unblank combination should be followed by a Stop Auxiliary (SX) command.



## Stop Auxiliary Command

- a. Syntax.                    SX <terminator>
- b. Explanation.

Stop Auxiliary (SX) ends the assignment of vectors and/or characters (picture information) to a WX blank/unblank combination.

SX performs the same function for WX that SN (Stop Naming) does for NF (Name File). This WX....SX bracketing of pictures provides the proper control so that pictures are shown only on the desired display(s).

The recommended command sequence is: (a) WX, Write Auxiliary; (b) NF, Name File (or other file commands such as UF); (c) Picture Information (PE, CS, PA, TX); (d) SN, Stop Naming; and (e) SX, Stop Auxiliary.

## Updating Displayed Information

We recommend that each picture be placed in a file (see Chapter 3).

When information shown on the display(s) needs to be changed, the Find File (FF) command may then be used and new vector/character commands entered into the picture file.

Changes in the picture content do not affect the WX blank/unblank combination.

## Multiple Picture Example.

Let's assume that the picture for display "1" is in file one, the picture for display "2" is in file two, the picture for display "3" is in file nine, and the picture for display "4" is in file twenty-seven.

In order to produce the four pictures on separate displays the 1350A should receive the following sequence of ASCII commands.

- a. "BF1,;BF2,;BF9,;BF27,;"

This blanks the four files being used for the pictures.

b. "WX14,;UF1,;SX;"

This turns display "1" on and sends it the picture in file one. The other three displays are blanked (turned off).

c. "WX13,;UF2,;SX;"

This turns on display "2" only and sends it the picture in file two.

d. "WX11,;UF9,;SX;"

This turns on display "3" only and sends it the picture in file nine.

e. "WX7,;UF27,;SX;"

This turns on display "4" only and sends it the picture in file twenty-seven.

## Hardware Picture Blinking

The 1350A can cause pictures to flash on and off the display(s) via internal switches (hardware). This will eliminate the need for software "blank file/wait/unblank file/wait" type of loops.

Hardware blinking will cause the picture to flash on and off the display approximately four times per second.

---

### NOTE

When 1350A hardware blinking is used, display "4" will always be blanked. Therefore, blinking is only possible on displays "1", "2", and "3".

---

Blinking is actually determined by both hardware and software. The hardware portion is configured by switches inside the 1350A. The software portion relies on the parameter used with a Write Auxiliary (WX) command.

## Blink Switches

In order to have displays "1", "2", or "3" blink, the corresponding Blinking Switch(es) must be turned on.

These switches are inside the 1350A cabinet and should be changed only by qualified service personnel. Refer service personnel to the Model 1350A Operating and Service manual, Section III.

The 1350A is shipped from the factory with all blink switches in the off position (no blinking possible).

## Write Auxiliary (WX) Effect on Blinking

Blinking is only possible when WX parameters 8 thru 15 are used. Blinking is not possible with WX parameters 0 thru 7.

Table 5-2 lists the blank/unblank-blink possibilities when using WX 8 thru 15. For a complete description of WX, see the Multiple Picture Displays section immediately preceeding this section.

**Table 5-2. Display Blank/Unblank-Blink Combinations for WX 8-15**

WX PARAMETER	DISPLAY			
	1	2	3	4
8	U*	U*	U*	B
9	B	U*	U*	B
10	U*	B	U*	B
11	B	B	U*	B
12	U*	U*	B	B
13	B	U*	B	B
14	U*	B	B	B
15	B	B	B	B

B = Blank (display off).

U\* = Unblank (display on) and blink if switch is on.

When using blinking, remember:

1. Blink switch(es) for the desired display(s) must be turned on.
2. Display "4" will always be blanked.
3. Display(s) to show a blinking picture must be unblanked (turned on) by a WX parameter.

## Color Display Control

The Hewlett-Packard Model 1338A Tri-color Display can be controlled by the 1350A. This allows a picture to be presented in three colors to aid in the differentiation of information.

See the Model 1338A Tri-color Display Operating and Service manual (Section III) for hook-up procedure.

The three colors are red, yellow, and green. For example, the axes on a graph may be red, the text labels for the axes yellow, and the actual data that is plotted can be green.

Another example would be a ground control radar display for managing aircraft. The local precipitation pattern could be shown by red vectors as a background for flight decisions. Flight boundaries can be shown by yellow vectors. Green text characters can then be used to highlight the actual aircraft. If the aircraft proximity becomes marginal, then the green may be changed to red in order to indicate danger and thus alert the ground controller.

The 1350A controls the color of data (vectors and/or characters) via files. The name of the 1350A file in which the data is contained will determine the color of the data.

## File Name Versus Color of Data

The 1350A Name File (NF) command controls the color of data. Table 5-3 lists 1350A file names and their respective colors.

Files are discussed in Chapter 3 of this manual. All data to be displayed in a certain color should be grouped together as per table 5-3 by using the Name File (NF) .... Stop Naming (SN) commands to mark off the desired files in 1350A memory.

**Table 5-3. Colors of Data Produced by 1350A Files**

FILE NAME (NF COMMAND PARAMETERS)	COLOR OF DATA
0 thru 7	GREEN
16 thru 31	YELLOW
40 thru 47	RED

All vectors and/or characters in file 5, for example, will be green when displayed by the 1338A Tri-color Display.

---

### NOTE

The normal range for NF parameters is from 0 to 31 (Chapter 3). This range is increased to be from 0 to 47 for color production. In color applications we recommend that NF parameters 8 thru 15 and 32 thru 39 should NOT be used. This prevents "foul-ups" in 1350A memory.

---

# Chapter 6

## Example Programs

### Introduction

This chapter contains four different example programs for the 1350A. Each program is presented in three languages: (1) HPL, which is used by the Hewlett-Packard Model 9825A Calculator; (2) BASIC; and (3) FORTRAN.

The four examples are:

1. Initialization and drawing a simple picture.
2. Drawing a geometric design by using variables.
3. Printing all available sizes and rotations of text.
4. File usage.

Each example program is preceded by a discussion of the intent of the program and the general procedure that will be used to produce the desired results. The actual programs have been commented to show how the general procedure is implemented in each language.

If you are using a different language, the comments and general procedures provide a base of information that aids the translation process. If problems are encountered, contact your nearest Hewlett-Packard office.

The BASIC and FORTRAN examples were done on a Hewlett-Packard System 1000 Computer. The HPL examples were done on an HP 9825A Calculator.

All program examples are for a 1350A equipped with the HP-IB interface. HP-IB (Hewlett-Packard Interface Bus) is Hewlett-Packard's implementation of IEEE Standard 488-1978, "Standard Digital Interface for Programmable Instrumentation."

For the HPL programs, the 9825A Calculator is an Option 002 (23K byte Read/Write memory) equipped with: 98034A HP-IB Interface; 98210A String-Advanced Programming ROM; 98213A General I/O - Extended I/O ROM.

For the BASIC programs, we used HP BASIC/1000D: HP92101-16001 REV. 1913 (781108).

---

#### NOTE

In BASIC, the ETX character (End of Text) is obtained by pressing the Control key (CNTL) and the capital C key at the same time. The DC4 character is obtained by pressing CNTL and capital T at the same time.

---

For the FORTRAN programs, we used FTN4 COMPILER: HP92060-16092 REV. 1913 (790206).

The System 1000 used for both BASIC and FORTRAN examples is equipped with RTE IV, Driver 37, and a 59310B I/O Card.

---

#### NOTE

For a 1350A with a serial prefix of 1920A and below, the initialization sequence must start with an Interface Clear (IFC) message from the HP-IB (Hewlett-Packard Interface Bus). IFC causes the talker and listener(s) on the bus to go to a quiescent state, so any conversation that was in progress will have to be reinstated by readdressing all participants. The BASIC command to send IFC is `CALL CLEAR(LUHPIB,2)` where LUHPIB is the logic unit number assigned to the bus. This command is loaded using RTETG (see HP BASIC/1000D manual, change 3, 4th Edition. The FORTRAN command to send IFC is `CALL EXEC(3,LUHPIB)`.

---

Each of the four examples is accompanied by a photo. The photo shows what the display should be, no matter which language is used in the example.

## Example 1: Initialization and Drawing a Simple Picture

Intent.

This example shows how to initialize the 1350A, draw a triangle, and print a title below the triangle. See figure 6-1.

General Procedure.

1. Initialize the 1350A with the following ASCII sequence.

ETX End of Text character (decimal 3) removes the 1350A from possible Text mode.

DC4 DC4 character (decimal 20) turns off 1350A POWER INTERRUPT light.

EM The EM command clears memory of vectors, text, and pen values.

EN EN command removes all file assignments from memory.

EX EX command removes all multiple display blanking assignments from memory.

SN SN command stops any possible file naming.

SX SX command stops any possible multiple display blanking assignment.

UM UM command places entire memory in an unblanked state.

Each of the commands must be followed by a valid <terminator>. The ASCII string is shown below using colon (:) terminators.

ETX DC4 :EM:EN:EX:SN:SX:UM:



## 2. Draw the triangle.

- a. Turn the beam off (lift the beam) with a PE0,; command.
- b. Move the beam to the starting point with a PAX1,Y1,; command. X1 = first X value; Y1 = first Y value.
- c. Turn the beam on (lower the beam) with a PE1,; command.
- d. Move the beam in the triangle pattern with a PAX2,Y2;X3,Y3;X1,Y1,; command.

The ASCII string is:

```
PE0,;PAX1,Y1,;PE1,;PAX2,Y2;X3,Y3;X1,Y1,;
```

## 3. Print the title.

- a. Turn the beam off with a PE0,; command.
- b. Move the beam to the starting point for the title with a PAX4,Y4,; command.
- c. Turn the beam on with a PE1,; command.
- d. Set the character size to "2" with a CS2,; command.
- e. Write the title with a TX1350A command.
- f. Exit Text mode with an ETX character.
- g. Terminate the Text command with a colon (:).

The ASCII string is:

```
PE0,;PAX4,Y4,;PE1,;CS2,;TX1350A ETX:
```



Figure 6-1. Example 1 Display

```

0: "                                                                                               ":
1: "  - - - - - EXAMPLE 1 - - - - -                                                                 ":
2: "                                                                                               ":
3: "                                                                                               ":
4: "              INITIALIZATION AND SIMPLE PLOTTING                                             ":
5: "                                                                                               ":
6: " initialize the 1350A by putting out an ASCII 3 to terminate any text,":
7: "   an ASCII 20 to clear the power interrupt light":
8: "   a SN to stop the naming of files":
9: "   a SX to stop any auxiliary action":
10: "   a EM to erase all vectors, characters, and beam controls":
11: "   a EN to erase all files":
12: "   a EX to erase all auxiliary actions":
13: "   and a UM to unblank memory":
14: "   All these commands are ended with the : terminator":
15: "   note: all output is directed to 718, 7 is the I/O channel (HPIB)":
16: "       and 18 is the select code (1350A I/O card must be set to 18)":
17: wtb 718,3,20,":sn:sx:em:en:ex:um:"
18: " draw a triangle by lifting the beam, moving it to the starting ":
19: " position, lowering the beam, and drawing the triangle":
20: wrt 718,"pe0,:pa300,300;:pel,:pa500,700;700,300;300,300;:"
21: " write the title by lifting the beam, moving it to the starting":
22: " position, lowering the beam, setting the character size, and":
23: " writing the title":
24: "   note: the 3 is an ETX which is used to exit TEXT mode":
25: wtb 718,"pe0,:pa390,175;:pel,:cs2,:tx1350A",3,":
26: stp
*20855

```

```

10 REM
20 REM - - - - - EXAMPLE 1 - - - - -
30 REM BASIC
40 REM
50 REM      INITIALIZATION AND SIMPLE PLOTTING
60 REM
70 REM SET THE ASCII ETX CODE (CONTROL C)
80 LET E$=""
90 REM SET THE ASCII DC4 CODE (CONTROL T)
100 LET D$=""
110 REM INITIALIZE THE 1350A BY PUTTING OUT AN ASCII 3 TO EXIT TEXT
120 REM MODE, AN ASCII 20 TO CLEAR THE POWER INTERRUPT LIGHT
130 REM A SN TO STOP NAMING OF FILES
140 REM A SX TO STOP ANY AUXILIARY ACTION
150 REM A EM TO ERASE ALL VECTORS, CHARACTERS, AND BEAM CONTROLS
160 REM A EN TO ERASE ALL FILES
170 REM A EX TO ERASE ALL AUXILIARY ACTIONS
180 REM AND A UM TO UNBLANK MEMORY
190 REM ALL THESE COMMANDS ARE ENDED WITH THE ; TERMINATOR
200 PRINT #18;E$,D$,";SN: SX:EM:EN:EX:UM:"
210 REM DRAW A TRIANGLE BY LIFTING THE BEAM, MOVING IT TO THE STARTING
220 REM POSITION, LOWERING THE BEAM, AND DRAWING THE TRIANGLE
230 PRINT #18;"PE0,:PA300,300;:PE1,:PA500,700;700,300;300,300;:"
240 REM WRITE THE TITLE BY LIFTING THE BEAM, MOVING IT TO THE STARTING
250 REM POSITION, LOWERING THE BEAM, SETTING THE CHARACTER SIZE, AND
260 REM WRITING THE TITLE
270 PRINT #18;"PE0,:PA390,175;:PE1,:CS2,:TX1350A",E$,";"
280 STOP
290 END

```

```

0001 FTN,L
0002 C
0003 C - - - - - EXAMPLE 1 - - - - -
0004 C          FORTRAN
0005 C
0006 C          INITIALIZATION AND SIMPLE PLOTTING
0007 C
0008 C          PROGRAM GMFE1
0009 C..... SET THE LU OF THE 1350A
0010 C          LU1350=18
0011 C..... SET THE ASCII ETX CODE IN THE UPPER 8 BITS
0012 C          IETX=3*256
0013 C..... SET THE ASCII DC4 CODE IN THE UPPER 8 BITS
0014 C          IDC4=20*256
0015 C..... INITIALIZE THE 1350A BY PUTTING OUT AN ASCII 3 TO EXIT TEXT MODE
0016 C..... AN ASCII 20 TO CLEAR THE POWER INTERRUPT LIGHT
0017 C..... A SN TO STOP THE NAMING OF FILES
0018 C..... A SX TO STOP ANY AUXILIARY ACTION
0019 C..... A EM TO ERASE ALL VECTORS, CHARACTERS, AND BEAM CONTROLS
0020 C..... A EN TO ERASE ALL FILES
0021 C..... A EX TO ERASE ALL AUXILIARY ACTION
0022 C..... AND A UM TO UNBLANK MEMORY
0023 C..... ALL THESE COMMANDS ARE TERMINATED WITH THE : TERMINATOR
0024 C          WRITE(LU1350,1) IETX,IDC4
0025 C          1 FORMAT(A1,A1,":SN: SX:EM:EN:EX:UM:")
0026 C..... DRAW A TRIANGLE BY LIFTING THE BEAM, MOVING IT TO THE STARTING
0027 C..... POSITION, LOWERING THE BEAM, AND DRAWING THE TRIANGLE
0028 C          WRITE(LU1350,2)
0029 C          2 FORMAT("PE0,:PA300,300,:PE1,:PA500,700;700,300;300,300;:")
0030 C..... WRITE THE TITLE BY LIFTING THE BEAM, MOVING IT TO THE STARTING
0031 C..... POSITION, LOWERING THE BEAM, SETTING THE CHARACTER SIZE, AND
0032 C..... WRITING THE TITLE
0033 C          WRITE(LU1350,3) IETX
0034 C          3 FORMAT("PE0,:PA390,175,:PE1,:CS2,:TX1350A",A1,":")
0035 C          STOP
0036 C          END

```

## Example 2: Drawing a Geometric Design by Using Variables

Intent.

This example shows how to draw an involved pattern (figure 6-2) that requires the use of formatted outputs in order to plot variables.

General Procedure.

1. Allocate two arrays.
2. Initialize the control variables.
  - a. Set the number of points to a prime number less than or equal to 31 ( $P=31$ ).
  - b. Set the radius to 500.
  - c. Set THETA to  $(2 \times \text{PI})/P$  (i.e., radians). PI is 3.14159...
  - d. Set the center to 511,511.
3. Compute the points on the outside of the circle.
4. Initialize the 1350A.
5. Move the beam to the starting point  $X[P], Y[P]$  by using the following format controls.
  - a. Turn the beam off with a PE0,; command.
  - b. Move the beam with a PA command. Do the following things to generate the proper command:
    - \* Convert  $X[P]$  to a 4 place integer (no decimal point).
    - \* Insert a comma.
    - \* Convert  $Y[P]$  to a 4 place integer (no decimal point).
    - \* Insert a semicolon (;) and a colon (:).

- c. Turn the beam on with a PE1,; command.

The format to do step 5 is:

```
"PE0,;PA" conv-4-Int "," conv-4-Int ";;PE1,;"
```

where conv-4-Int means to convert to a 4 place integer and all the characters within the quote marks are required ASCII entries. Note: Conv-4-Int is f4.0 in HPL, 4D in BASIC, and I4 in FORTRAN.

- 6. Plot the design again using a format similar to step 5, except it only uses the following items.

```
"PA" conv-4-Int "," conv-4-Int ";;"
```

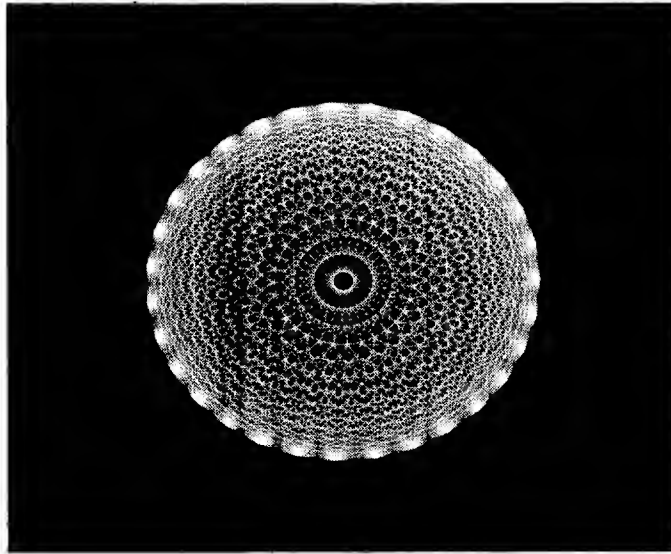


Figure 6-2. Example 2 Display

```

0: "
1: " - - - - - EXAMPLE 2 - - - - - "
2: " HPL "
3: " "
4: " DRAWS A GEOMETRIC DESIGN (PLOTting WITH FORMATTED VARIABLES) "
5: "
6: dim X[31],Y[31]
7: " set up the plotting formats":
8: fmt 1,"pe0,:pa",f4.0,"",f4.0,";:pe1,:"
9: fmt 2,"pa",f4.0,"",f4.0,";:"
10: " set the number of points - must be a prime number":31→P
11: " set the radius":500→R
12: " set theta in radians":rad;2*π/P→T
13: " set the center of the design":511→A→B
14: " compute the outside points of the design":
15: for I=1 to P;T*I→Z;R*cos(Z)+A→X[I];R*sin(Z)+B→Y[I];next I
16: " initialize the 1350A":
17: wtb 718,3,20,":sn:sx:em:en:ex:um:"
18: " move the beam to the starting position":
19: int(P/2)→N;wrt 718.1,X[P],Y[P]
20: " draw the geometric design":
21: for K=1 to N;K→L
22: for C=1 to P
23: wrt 718.2,X[L],Y[L];L+K→L
24: if L>P;L-P→L
25: next C
26: next K
27: stp
*8718

```

```

10 REM
20 REM - - - - - EXAMPLE 2 - - - - -
30 REM BASIC
40 REM
50 REM DRAW A GEOMETRIC DESIGN (PLOTING WITH FORMATTED VARIABLES)
60 REM
70 DIM X[31],Y[31]
80 REM SET THE ASCII ETX CODE (CONTROL C)
90 LET E$=""
100 REM SET THE ASCII DC4 CODE (CONTROL T)
110 LET D$=""
120 REM SET THE NUMBER OF POINTS, MUST BE A PRIME LESS THAN 32
130 LET P=31
140 REM SET THE RADIUS
150 LET R=500
160 REM SET THETA IN RADIANS
170 LET T=2*3.14159/P
180 REM SET THE CENTER OF THE SCREEN
190 LET C=511
200 REM COMPUTE THE OUTSIDE POINTS
210 FOR I=1 TO P
220 LET S=T*I
230 LET X[I]=R*COS(S)+C
240 LET Y[I]=R*SIN(S)+C
250 NEXT I
260 REM INITIALIZE THE 1350A
270 PRINT #18;E$,D$,":SN: SX:EM:EN:EX:UM:"
280 REM MOVE THE BEAM TO THE STARTING POSITION
290 PRINT #18 USING 300;X[P],Y[P]
300 IMAGE "PE0,:PA",4D,"",4D,"";PE1,:"
310 REM DRAW THE GEOMETRIC DESIGN
320 FOR I=1 TO P/2
330 LET L=I
340 FOR J=1 TO P
350 PRINT #18 USING 360;X[L],Y[L]
360 IMAGE "PA",4D,"",4D,"";:"
370 LET L=L+I
380 IF L>P LET L=L-P
390 NEXT J
400 NEXT I
410 STOP
420 END

```



```

0001  FTN,L
0002  C
0003  C - - - - - EXAMPLE 2 - - - - -
0004  C                               FORTRAN
0005  C
0006  C  DRAW A GEOMETRIC DESIGN  (PLOTING WITH FORMATTED VARIABLES)
0007  C
0008      PROGRAM GMFE2
0009      DIMENSION IX(31),IY(31)
0010  C.....  SET THE LU OF THE 1350A
0011      LU1350=18
0012  C.....  SET THE ASCII ETX CODE IN THE UPPER 8 BITS
0013      IETX=3*256
0014  C.....  SET THE ASCII DC4 CODE IN THE UPPER 8 BITS
0015      IDC4=20*256
0016  C.....  SET THE NUMBER OF POINTS, MUST BE A PRIME LESS THAN 32
0017      IPTS=31
0018  C.....  SET THE RADIUS
0019      RAD=500.
0020  C.....  SET THETA IN RADIANS
0021      THETA=2*3.141592654/FLOAT(IPTS)
0022  C.....  SET THE CENTER OF THE DESIGN
0023      IXC=511
0024      IYC=511
0025  C.....  COMPUTE THE OUTSIDE POINTS
0026      DO 1 I=1,IPTS
0027          S=THETA*FLOAT(I)
0028          IX(I)=IFIX(RAD*COS(S))+IXC
0029          IY(I)=IFIX(RAD*SIN(S))+IYC
0030      1 CONTINUE
0031  C.....  INITIALIZE THE 1350A
0032      WRITE(LU1350,2) IETX,IDC4
0033      2 FORMAT(A1,A1," :SN: SX:EM:EN:EX:UM:")
0034  C.....  MOVE THE BEAM TO THE STARTING POSITION
0035      WRITE(LU1350,3) IX(IPTS),IY(IPTS)
0036      3 FORMAT("PE0, :PA",I4," ",",I4," ";:PE1, :")
0037  C.....  DRAW THE GEOMETRIC DESIGN
0038      DO 5 I=1,IPTS/2
0039          L=I
0040          DO 5 J=1,IPTS
0041              WRITE(LU1350,4) IX(L),IY(L)
0042          4      FORMAT("PA",I4," ",",I4," ";:")
0043              L=L+I
0044              IF(L.GT.IPTS) L=L-IPTS
0045      5 CONTINUE
0046      STOP
0047      END

```

### Example 3: Printing All Available Sizes and Rotations of Text

Intent.

This example shows how to generate text on the display (see figure 6-3).

General Procedure.

1. Initialize the 1350A.
2. Write text.
  - a. Set the size and rotation for the characters with a CS<size>,; command.
  - b. Turn the beam off with a PE0;, command.
  - c. Move the beam to the starting point with a PAX,Y;, command.
  - d. Turn the beam on with a PE1;, command.
  - e. Print the message with a TX<string> command.
  - f. Exit Text mode with an ETX (End of Text) character.
  - g. Terminate TX command with a colon (:).

The ASCII string to do this is:

```
CS0,;PE0,;PAX,Y,;PE1,;TXmessage ETX:
```

where CS0,; is used as an example of the CS<size>,; command.



Figure 6-3. Example 3 Display

```

0: "
1: "  - - - - - EXAMPLE 3 - - - - - "
2: "                                HPL                                "
3: "
4: "                                SHOWS USES OF TEXT OUTPUT            "
5: "
6: " initialize the 1350A":
7: wtb 718,3,20,":sn:sx:em:en:ex:um:"
8: " write the text - stating character size, beam up, position beam, ":
9: "   beam down, and message":
10: wtb 718,"cs3,:pe0,:pa0,860,:pel,:txTHE 1350A",3,":"
11: wtb 718,"cs2,:pe0,:pa0,700,:pel,:txoffers TEXT",3,":"
12: wtb 718,"cs1,:pe0,:pa0,600,:pel,:txin FOUR",3,":"
13: wtb 718,"cs0,:pe0,:pa0,500,:pel,:txSIZES",3,":"
14: wtb 718,"cs7,:pe0,:pa680,0,:pel,:txAT TWO",3,":"
15: wtb 718,"cs6,:pe0,:pa820,0,:pel,:txdifferent",3,":"
16: wtb 718,"cs5,:pe0,:pa920,0,:pel,:txANGLES in BOTH",3,":"
17: wtb 718,"cs4,:pe0,:pa1000,0,:pel,:txUPPER and lower CASE",3,":"
18: stp
*7995

```

```

10 REM
20 REM - - - - - EXAMPLE 3 - - - - -
30 REM BASIC
40 REM
50 REM SHOWS USES OF TEXT OUTPUT
60 REM
70 REM SET THE ASCII ETX CODE (CONTROL C)
80 LET E$=""
90 REM SET THE ASCII DC4 CODE (CONTROL T)
100 LET D$=""
110 REM INITIALIZE THE 1350A
120 PRINT #18;E$,D$,":SN: SX:EM:EN:EX:UM:"
130 REM WRITE TEXT BY STATING THE CHARACTER SIZE, BEAM UP, POSITION
140 REM BEAM, BEAM DOWN, TEXT COMMAND WITH THE MESSAGE
150 PRINT #18;"CS3,:PE0,:PA0,860;:PE1,:TXTHE 1350A",E$,";"
160 PRINT #18;"CS2,:PE0,:PA0,700;:PE1,:TXoffers TEXT",E$,";"
170 PRINT #18;"CS1,:PE0,:PA0,600;:PE1,:TXin FOUR",E$,";"
180 PRINT #18;"CS0,:PE0,:PA0,500;:PE1,:TXSIZES",E$,";"
190 PRINT #18;"CS7,:PE0,:PA680,0;:PE1,:TXAT TWO",E$,";"
200 PRINT #18;"CS6,:PE0,:PA820,0;:PE1,:TXdifferent",E$,";"
210 PRINT #18;"CS5,:PE0,:PA920,0;:PE1,:TXANGLES in BOTH",E$,";"
220 PRINT #18;"CS4,:PE0,:PA1000,0;:PE1,:TXUPPER and lower CASE",E$,";"
230 STOP
240 END

```

```

0001 FTM,L
0002 C
0003 C - - - - - EXAMPLE 3 - - - - -
0004 C FORTRAN
0005 C
0006 C SHOWS USES OF TEXT OUTPUT
0007 C
0008 C PROGRAM GMFE3
0009 C..... SET THE LU OF THE 1350A
0010 C..... LU1350=18
0011 C..... SET THE ASCII ETX CODE IN THE UPPER 8 BITS
0012 C..... IETX=3*256
0013 C..... SET THE ASCII DC4 CODE IN THE UPPER 8 BITS
0014 C..... IDC4=20*256
0015 C..... INITIALIZE THE 1350A
0016 C..... WRITE(LU1350,1) IETX,IDC4
0017 C..... 1 FORMAT(A1,A1,":SN: SX:EM:EN:EX:UM:")
0018 C..... WRITE TEXT BY STATING THE CHARACTER SIZE, BEAM UP, POSITION
0019 C..... BEAM, BEAM DOWN, TEXT COMMAND WITH THE MESSAGE
0020 C..... WRITE(LU1350,2) IETX
0021 C..... 2 FORMAT("CS3,:PE0,:PA0,860;:PE1,:TXTHE 1350A",A1,";")
0022 C..... WRITE(LU1350,3) IETX
0023 C..... 3 FORMAT("CS2,:PE0,:PA0,700;:PE1,:TXoffers TEXT",A1,";")
0024 C..... WRITE(LU1350,4) IETX
0025 C..... 4 FORMAT("CS1,:PE0,:PA0,600;:PE1,:TXin FOUR",A1,";")
0026 C..... WRITE(LU1350,5) IETX
0027 C..... 5 FORMAT("CS0,:PE0,:PA0,500;:PE1,:TXSIZES",A1,";")
0028 C..... WRITE(LU1350,6) IETX
0029 C..... 6 FORMAT("CS7,:PE0,:PA680,0;:PE1,:TXAT TWO",A1,";")
0030 C..... WRITE(LU1350,7) IETX
0031 C..... 7 FORMAT("CS6,:PE0,:PA820,0;:PE1,:TXdifferent",A1,";")
0032 C..... WRITE(LU1350,8) IETX
0033 C..... 8 FORMAT("CS5,:PE0,:PA920,0;:PE1,:TXANGLES in BOTH",A1,";")
0034 C..... WRITE(LU1350,9) IETX
0035 C..... 9 FORMAT("CS4,:PE0,:PA1000,0;:PE1,:TXUPPER and lower CASE",A1,";")
0036 C..... STOP
0037 C..... END

```

## Example 4: File Usage

Intent.

This example shows how to construct files (figure 6-4), blink a file, erase a file, and update a file (figure 6-5). In addition, this example also shows how to plot special symbols to aid in line differentiation.

General Procedure.

1. Initialize the 1350A.
2. Draw the axes and print the title.
3. Place curve 1 into 1350A file 1 by naming the file with an NF1,; command. Also be sure that the beam is off with a PE0,; command.
4. Compute and scale the data point for plotting.
5. Plot the point by using the following format.

```
"PA" conv-4-Int "," conv-4-Int ";;PE1,;"
```

---

### NOTE

See example 3 for definitions used in this format.

---

6. Repeat steps 4 and 5 for all data points to complete the drawing of curve 1.
7. Stop placing data in file 1 with an SN: command.
8. Place curve 2 into 1350A file 2 with a NF2,; command. Also set the character size to 1 with a CS1,; command.
9. Draw curve 2 using a special plotting character. We will use the vertical tick (decimal 11) to designate each data point on the curve.

---

**NOTE**

Other special plotting characters include: horizontal tick (12); X marker (14); rectangle (15); and a diamond (30). These characters are unique because they do not advance the beam like normal text characters would, and thus are used for plotting. Since the beam is not advanced, these symbols can be combined at each data point to produce special symbols (for example, a vertical and horizontal tick at the same data point combine to form a + symbol). The special plotting characters are affected by the character size command in the same way as all other text characters.

---

- a. Turn the beam on with a PE1,: command.
- b. Move the beam to the data point with a PA command.
- c. Output the text character (vertical tick).
- d. Use an ETX character and a colon (:) to end the text command.

The format is as follows:

"PE1,:PA" conv-4-Int ",", conv-4-Int ":",TX" 1AC ETX ":"

where 1AC means to output an ASCII character. In HPL this is 1b, in BASIC it's A, and in FORTRAN it's A1.

10. Repeat steps 8 and 9 for all data points in curve 2.
11. Stop placing data in file 2 with an SN: command.
12. Place curve 3 in 1350A file 3 with a NF3,: command.
13. Draw curve 3 using the special plotting characters of a vertical tick (11) and a horizontal tick (12) at each data point.
  - a. Turn the beam off with a PE0,: command.

- b. Move the beam to the data point with a PA command.
- c. Turn the beam on with a PE1,: command.
- d. Output the Text characters (vertical and horizontal ticks)
- e. Use an ETX character and a colon (:) to end the text command.

The format is as follows:

“PE0,:PA” conv-4-Int “,” conv-4-Int “,:PE1,:TX” 1AC 1AC ETX“:”

- 14. Stop placing data in file 3 with an SN: command.
- 15. Blink file 3 the desired number of times.
  - a. Blank file 3 with a BF3,: command.
  - b. Wait some length of time.
  - c. Unblank file 3 with a UF3,: command.
  - d. Wait some length of time.
  - e. Repeat.
- 16. Erase all vector, text, and beam control contents from file 2 with an EF2,: command.
- 17. Update the contents of file 1.
  - a. Move the Write Pointer to the first word in 1350A file 1 with a FF1,: command.
  - b. Update the file by outputting new curve information with the same method that it was first entered in steps 4-6.

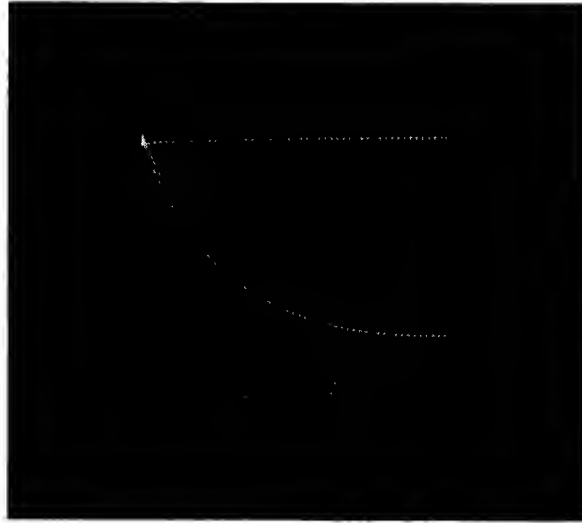


Figure 6-4. Example 4: All Three Files Displayed

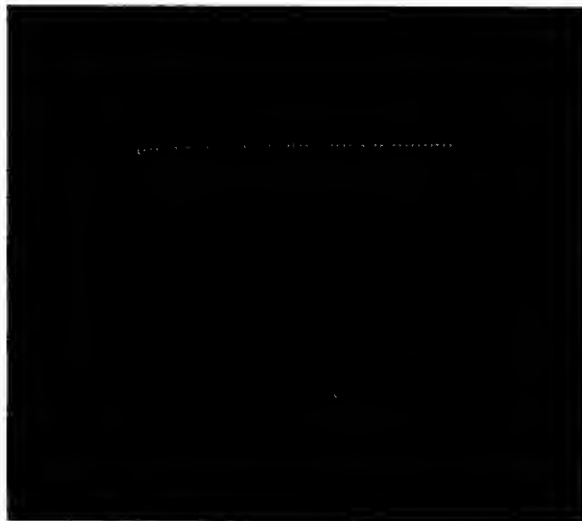


Figure 6-5. Example 5: File 2 Has Been Erased; File 1 is Being Updated



```

0: "
1: "  - - - - - EXAMPLE 4 - - - - - "
2: "                                HPL "
3: "                                "
4: "                                1350A FILE USAGE "
5: "                                "
6: fmt 1,"pa",f4.0,"",f4.0,";:pel,:"
7: fmt 2,"pa",f4.0,"",f4.0,";:pel,:tx",lb,lb,":"
8: fmt 3,"pe0,:pa",f4.0,"",f4.0,";:pel,:tx",lb,lb,lb,":"
9: " initialize the 1350A":
10: wtb 718,3,20,":sn:sx:em:en:ex:um:"
11: " print the title":
12: wtb 718,"pe0,:pa315,40;:pel,:cs2,:txFILE USAGE",3,":"
13: " set the system to radians":rad
14: " draw the axes":
15: wrt 718,"pe0,:pa158,800;:pel,:pa158,130;950,130;:"
16: " compute and draw curve 1, putting it into 1350A file 1":
17: wrt 718,"nfl,:pe0,:"
18: for I=10 to 60
19: " compute the data point":
20: I/10→A
21: -9ln(A)+2ln(2)A-2.5+50tan(A/360*2*π)→B
22: " scale the data point for plotting":
23: A*158.7→X;800+B*66.6→Y
24: " plot the point":wrt 718.1,X,Y
25: next I
26: " stop placing data in file 1":
27: " compute and draw curve 2, putting it into 1350A file 2":
28: wrt 718,"sn:nf2,:cs1,:pe0,:"
29: for I=10 to 60
30: " compute the data point":
31: I/10→A
32: -9ln(A)-2+90tan(A/360*2*π)→B
33: " scale the data point for plotting":
34: A*158.7→X;800+B*66.6→Y
35: " plot the point as a vertical tick (11)":
36: wrt 718.2,X,Y,11,3
37: next I
38: " stop placing data in file 2":
39: " compute and draw curve 3, putting it into 1350A file 3":
40: wrt 718,"sn:nf3,:"
41: for I=10 to 60
42: " compute the data point":
43: I/10→A
44: .21*ln(A)-.6→B
45: " scale the data point for plotting":
46: A*158.7→X;800+B*66.6→Y
47: " plot the point as a vert tick (11) and a horz tick (12)":
48: wrt 718.3,X,Y,11,12,3
49: next I
50: " stop naming file 3":wrt 718,"sn:"

```

```

51: " blink 1350A file 3 by a blank/wait/unblank/wait loop":
52: for I=1 to 10
53: wrt 718,"bf3,:";wait 200
54: wrt 718,"uf3,:";wait 200
55: next I
56: wait 2000
57: " erase 1350A file 2":wrt 718,"ef2,:"
58: wait 2000
59: " change file 1 to show a new curve":
60: "   find the starting position of 1350A file 1":
61: wrt 718,"ff1,:pe0,:"
62: "   compute the new curve":
63: for I=10 to 60
64: "   compute the data point":
65: I/10+A
66: -7ln(A)+ln(2)A-2.5+65tan(A/360*2*π)+B
67: "   scale the data for plotting":
68: A*158.7+X;800+B*66.6+Y
69: " plot the new point":
70: wrt 718.1,X,Y
71: next I
72: stp
*14942

```

```

10 REM
20 REM - - - - - EXAMPLE 4 - - - - -
30 REM BASIC
40 REM
50 REM FILE USAGE
60 REM
70 REM SET THE ASCII ETX CODE (CONTROL C)
80 LET E$=""
90 REM SET THE ASCII DC4 CODE (CONTROL T)
100 LET D$=""
110 REM SET THE ASCII CODE FOR A HORIZONTAL TICK (CONTROL L)
120 LET H$=""
130 REM SET THE ASCII CODE FOR A VERTICAL TICK (CONTROL K)
140 LET V$=""
150 REM INITIALIZE THE 1350A
160 PRINT #18;E$,D$,";SN;SX;EM;EN;EX;UM;"
170 REM PRINT THE TITLE
180 PRINT #18;"PE0,;PA315,40;;PE1,;CS2,;TXFILE USAGE",E$,";"
190 REM DRAW THE AXES
200 PRINT #18;"PE0,;PA158,800;;PE1,;PA158,130;950,130;:"
210 REM SET THE VALUE OF 2*PI
220 LET T=2*3.14159
230 REM COMPUTE AND DRAW CURVE 1, PUTTING IT INTO 1350A FILE 1
240 PRINT #18;"NF1,;PE0,;"
250 FOR I=10 TO 60
260 REM COMPUTE THE DATA POINT
270 LET A=I/10
280 LET B=-9*LN(A)+2*LN(2)*A-2.5+50*TAN(A/360*T)
290 REM SCALE THE DATA POINT FOR PLOTTING
300 LET X=A*158.7
310 LET Y=800+B*66.6
320 REM PLOT THE POINT
330 PRINT #18 USING 340;X,Y
340 IMAGE "PA",4D,"",4D,"";PE1,;"
350 NEXT I
360 REM STOP PLACING DATA IN FILE 1
370 REM COMPUTE AND DRAW CURVE 2, PUTTING IT INTO 1350A FILE 2
380 PRINT #18;"SN:NF2,;CS1,;PE0,;"
390 FOR I=10 TO 60
400 REM COMPUTE THE DATA POINT
410 LET A=I/10
420 LET B=-9*LN(A)-2+90*TAN(A/360*T)
430 REM SCALE THE DATA POINT FOR PLOTTING
440 LET X=A*158.7
450 LET Y=800+B*66.6
460 REM PLOT THE POINT AS A VERTICAL TICK (11)
470 PRINT #18 USING 480;X,Y,V$,E$
480 IMAGE "PA",4D,"",4D,"";PE1,;TX",A,A,;"
490 NEXT I
500 REM STOP PLACING DATA IN FILE 2
510 REM COMPUTE AND DRAW CURVE 3, PUTTING IT INTO 1350A FILE 3
520 PRINT #18;"SN:NF3,;"
530 FOR I=10 TO 60
540 REM COMPUTE THE DATA POINT
550 LET A=I/10
560 LET B=.21*LN(A)-.6
570 REM SCALE THE DATA POINT FOR PLOTTING
580 LET X=A*158.7
590 LET Y=800+B*66.6
600 REM PLOT THE POINT AS A HORIZ TICK (12) AND A VERT TICK (11)

```

```

610     PRINT #18 USING 620;X,Y,H*,V*,E*
620     IMAGE "PE0,:PA",4D,"",",4D,"";:PE1,:TX",A,A,A,";"
630     NEXT I
640 REM   STOP NAMING FILE 3
650 PRINT #18;"SN:"
660 REM   BLINK FILE 3 BY A BLANK WAIT UNBLANK WAIT LOOP
670     FOR I=1 TO 10
680         PRINT #18;"BF3,:"
690         WAIT (200)
700         PRINT #18;"UF3,:"
710         WAIT (200)
720     NEXT I
730 WAIT (2000)
740 REM   ERASE FILE 2
750 PRINT #18;"EF2,:"
760 WAIT (2000)
770 REM   CHANGE FILE 1 TO SHOW A NEW CURVE
780 REM   FIND THE STARTING POSITION OF FILE 1
790 PRINT #18;"FF1,:PE0,:"
800 REM   COMPUTE THE NEW CURVE
810     FOR I=10 TO 60
820         REM   COMPUTE THE DATA POINT
830         LET A=I/10
840         LET B=-7*LN(A)+LN(2)*A-2.5+65*TAN(A/360*T)
850         REM   SCALE THE DATA POINT FOR PLOTTING
860         LET X=A*158.7
870         LET Y=800+B*66.4
880         REM   PLOT THE NEW POINT
890         PRINT #18 USING 340;X,Y
900     NEXT I
910 STOP
920 END

```

```

0001  FTN,L
0002  C
0003  C - - - - - EXAMPLE 4 - - - - -
0004  C                               FORTRAN
0005  C
0006  C                               1350A FILE USAGE
0007  C
0008      PROGRAM GMFE4
0009  C.....  SET THE LU OF THE 1350A
0010      LU1350=18
0011  C.....  SET THE ASCII ETX CODE IN THE UPPER 8 BITS
0012      IETX=3*256
0013  C.....  SET THE ASCII DC4 CODE IN THE UPPER 8 BITS
0014      IDC4=20*256
0015  C.....  SET THE ASCII CODE FOR A VERTICAL TICK (11)
0016      IVT=11*256
0017  C.....  SET THE ASCII CODE FOR A HORIZONTAL TICK (12)
0018      IHT=12*256
0019  C.....  INITIALIZE THE 1350A
0020      WRITE(LU1350,1) IETX,IDC4
0021      1 FORMAT(A1,A1,";SN;SX;EM;EN;EX;UM:")
0022  C.....  PRINT THE TITLE
0023      WRITE(LU1350,2) IETX
0024      2 FORMAT("PE0,;PA315,40;;PE1,;CS2,;TXFILE USAGE",A1,";")
0025  C.....  DRAW THE AXIS
0026      WRITE(LU1350,3)
0027      3 FORMAT("PE0,;PA158,800;;PE1,;PA158,130;950,130;;")
0028  C.....  SET THE VALUE OF 2*PI
0029      TWOPI=2.*3.141592654
0030  C.....  COMPUTE AND DRAW CURVE 1, PUTTING IT INTO FILE 1
0031      WRITE(LU1350,4)
0032      4 FORMAT("NF1,;PE0,;")
0033      DO 6 I=10,60
0034  C.....  COMPUTE THE DATA POINT
0035      A=FLOAT(I)/10.
0036      B=-9.*ALOG(A)+2.*ALOG(2.)*A-2.5+50.*TAN(A/360.*TWOPI)
0037  C.....  SCALE THE DATA POINT FOR PLOTTING
0038      IX=IFIX(A*158.7)
0039      IY=IFIX(800.+B*66.6)
0040  C.....  PLOT THE POINT
0041      WRITE(LU1350,5) IX,IY
0042      5 FORMAT("PA",I4,";",I4,";;PE1,;")
0043      6 CONTINUE
0044  C.....  STOP PLACING DATA IN FILE 1
0045  C.....  COMPUTE AND DRAW CURVE 2, PUTTING IT INTO FILE 2
0046      WRITE(LU1350,7)
0047      7 FORMAT("SN:NF2,;CS1,;PE0,;")
0048      DO 9 I=10,60
0049  C.....  COMPUTE THE DATA POINT
0050      A=FLOAT(I)/10.
0051      B=-9.*ALOG(A)-2.+90.*TAN(A/360.*TWOPI)
0052  C.....  SCALE THE DATA POINT FOR PLOTTING
0053      IX=IFIX(A*158.7)
0054      IY=IFIX(800.+B*66.6)
0055  C.....  PLOT THE POINT AS A VERTICAL TICK (11)

```

```

0056      WRITE(LU1350,8) IX,IY,IVT,IETX
0057      8  FORMAT("PA",I4,"",",",I4,"";:PE1,:TX",A1,A1,"")
0058      9  CONTINUE
0059  C..... STOP PLACING DATA IN FILE 2
0060  C..... COMPUTE AND DRAW CURVE 3, PUTTING IT INTO FILE 3
0061      WRITE(LU1350,10)
0062      10 FORMAT("SN:N3,:")
0063      DO 12 I=10,60
0064  C..... COMPUTE THE DATA POINT
0065      A=FLOAT(I)/10.
0066      B=.21*ALOG(A)-.6
0067  C..... SCALE THE DATA POINT FOR PLOTTING
0068      IX=IFIX(A*158.7)
0069      IY=IFIX(800.+B*66.6)
0070  C..... PLOT THE POINT AS A HORZ TICK (12) AND A VERT TICK (11)
0071      WRITE(LU1350,11) IX,IY,IVT,IHT,IETX
0072      11  FORMAT("PE0,:PA",I4,"",",",I4,"";:PE1,:TX",A1,A1,A1,"")
0073      12 CONTINUE
0074  C..... STOP NAMING FILE 3
0075      WRITE(LU1350,13)
0076      13 FORMAT("SN:")
0077  C..... BLINK FILE 3 BY A BLANK/WAIT/UNBLANK/WAIT LOOP
0078      DO 16 I=1,10
0079      WRITE(LU1350,14)
0080      14  FORMAT("BF3,:")
0081      CALL EXEC(12,0,1,0,-20)
0082      WRITE(LU1350,15)
0083      15  FORMAT("UF3,:")
0084      CALL EXEC(12,0,1,0,-20)
0085      16 CONTINUE
0086      CALL EXEC(12,0,1,0,-200)
0087  C..... ERASE FILE 2
0088      WRITE(LU1350,17)
0089      17 FORMAT("EF2,:")
0090      CALL EXEC(12,0,1,0,-200)
0091  C..... CHANGE FILE 1 TO SHOW A NEW CURVE
0092  C..... FIND THE STARTING POSITION OF FILE 1
0093      WRITE(LU1350,18)
0094      18 FORMAT("FF1,:PE0,:")
0095  C..... COMPUTE THE NEW CURVE
0096      DO 19 I=10,60
0097  C..... COMPUTE THE DATA POINT
0098      A=FLOAT(I)/10.
0099      B=-7.*ALOG(A)+ALOG(2.)*A-2.5+65.*TAN(A/360.*TWOPI)
0100  C..... SCALE THE DATA POINT FOR PLOTTING
0101      IX=IFIX(A*158.7)
0102      IY=IFIX(800.+B*66.6)
0103  C..... PLOT THE NEW POINT
0104      WRITE(LU1350,5) IX,IY
0105      19 CONTINUE
0106      STOP
0107      END

```



## Appendix **A**

# AC Power Requirements

The 1350A Graphics Translator requires a power source of 100, 120, 220, or 240 volts AC  $\pm 5\%$ – $10\%$ , single phase, 48 Hz to 440 Hz. Average power dissipation at 60 Hz, 120 V without any options is approximately 80 watts.

### CAUTION

INSTRUMENT DAMAGE MAY RESULT IF THE LINE VOLTAGE SELECTION SWITCHES ARE NOT SET CORRECTLY FOR THE INPUT POWER SOURCE BEING USED.

The instrument is normally set at the factory for the applicable line voltage of the shipment destination. However, this selection should be checked before applying power.

To operate the instrument from any other AC power source, proceed as follows:

1. Disconnect the 1350A power cord from the power source.
2. Using a blade-type screwdriver, position the rear-panel Line Voltage Select switches for the desired AC voltage input.
3. For 220 V - 240 V inputs, replace the rear-panel fuse F1 with the 800 mA fuse (HP Part Number 2110-0020).
4. Connect the 1350A input power cord to the power source.

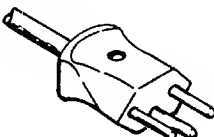
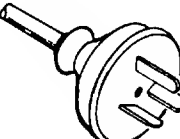
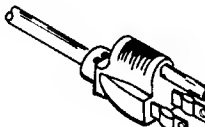
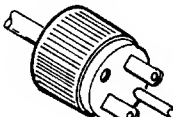
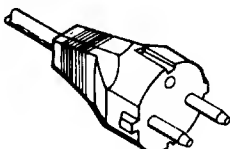
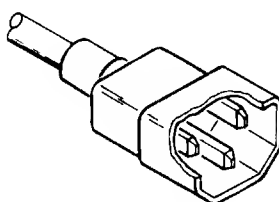
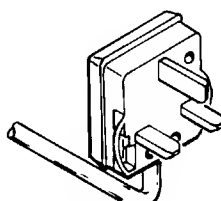




Appendix **B**

Power Cord

The Power Cord required depends on the AC input voltage and the country in which the instrument is to be used. The following figure illustrates standard power receptacle (wall outlet) configurations. The HP Part Number shown above each receptacle drawing specifies the power cord equipped with the appropriate mating plug for that receptacle. If the appropriate power cord is not included with your instrument, notify the nearest HP Sales/Service Office and a replacement cord will be provided.

<div>250V OPERATION</div> <div></div> <div>OPT 906 CABLE*: HP 8120-2104</div>	<div>250V OPERATION</div> <div></div> <div>OPT 901 CABLE*: HP 8120-1369</div>	<div>125V OPERATION</div> <div></div> <div>STD CABLE*: HP 8120-2061</div>	<div>250V OPERATION</div> <div></div> <div>OPT 904 CABLE*: HP 8120-0698</div>
<div>250V OPERATION</div> <div></div> <div>OPT 902 CABLE*: HP 8120-1689</div>	<div>250V OPERATION</div> <div></div> <div>OPT 905 CABLE*: HP 8120-1396</div>	<div>250V OPERATION</div> <div></div> <div>OPT 900 CABLE: HP 8120-1351</div>	
<div>*The number shown for the cable is an HP Part number for a complete cable including the plug.</div>			

HP Power Cord Part Numbers



## Appendix **C**

# Auxiliary Connector

The Auxiliary Connector is provided on the rear panel for connecting the 1350A to the Hewlett-Packard Model 1338A Tri-color Display.

The signals interfacing the 1350A and 1338A may also be used for other applications. The applications are numerous, and beyond the scope of this manual.

The Hewlett-Packard Part Number for the connector that mates with the Auxiliary Connector is 1251-0063. The Manufacturer's Part Number is ITT DBM-25P.

All signals, input or output, at the Auxiliary Connector are standard TTL levels.

Following is a description of all 25 pins.

Pin 1. No connection.

Pin 2. No connection.

Pin 3. No connection.

Pin 4. Same as BNC connector for DISPLAY 1. Unblanks Display 1 of 4 to display information.

Pin 5. Same as BNC connector for DISPLAY 2. Unblanks Display 2 of 4 to display information.

Pin 6. When pin 6 is low, the 1350A is indicating to the device connected to the Auxiliary Connector that it should be in a remote mode, ready to accept information from the 1350A. Pin 6 is also used as a power up reset, holding off pin 9 and pin 13 operation during the reset period.

Pins 7, 8. Pins 7 and 8 provide a 2 bit binary code indicating the color being output by the 1350A. As indicated in Appendix D the color is determined by the file names being used.

Binary Color Code

FILE NAME	COLOR	MSB PIN 7	LSB PIN 8
16-31	Yellow	0	0
32-47	Red	0	1
48-63*	Yellow	1	0
0-15	Green	1	1

\*Files 48-63 not used due to "Wrap-around".

Pin 9. Pin 9 is a positive edge clock that occurs within 25 ns minimum after the binary data. The color data is valid only at the clock edge.

Pin 10. Pin 10 is low while drawing vectors in the 1350A.

Pin 11. Pin 11 is +5 V supply with a 10 ohm resistor in series.

Pin 12. Pin 12 is +5 V supply with a 10 kohm resistor in series.

Pin 13. A low state from the device connected to the Auxiliary Connector will hold-off the 1350A from outputting vectors.

Pin 14, 15, 16. Internal 1350A grounds for signals.

Pin 17. Same as BNC connector for DISPLAY 3. Unblanks Display 3 of 4 to display information.

Pin 18. Same as BNC connector for DISPLAY 4. Unblanks Display 4 of 4 to display information.

Pins 19-25. Internal 1350A grounds for +5 V supply and chassis ground.

## Appendix **D**

# File Names for 1338A Tri-color Applications

This section describes the unique use of Files for selecting the color in the 1338A Tri Color Display (refer to Chapter 5 "Files" of this manual).

The File Name (NF) determines the binary code sent to the 1338A. The following table shows the file names and the corresponding colors. Files greater than 47 must not be used due to "Wrap-around".

GREEN	YELLOW	RED
0	16	32
1	17	33
2	18	34
3	19	35
4	20	36
5	21	37
6	22	38
7	23	39
8	24	40
9	25	41
10	26	42
11	27	43
12	28	44
13	29	45
14	30	46
15	31	47

Only 32 files (0 through 31) are used in the 1350A. However, file names 0-47 are necessary to select all three colors in the 1338A.

Files names 32 through 47 "Wrap-around" into files 0 through 15. For example, data entered into file 35 is displayed in red by the 1338A, but due to "Wrap-around" the data is automatically stored in file 3 by the 1350A.



As shown in the following example, files 0 through 7 are used for green, therefore files 32 through 39 cannot be used for red. Conversely files used for red must be able to "Wrap-around" into the unused green files.

	GREEN	YELLOW	RED	
GREEN FILES	0	16	32	CAN NOT BE USED FOR RED
	1	17	33	
	2	18	34	
	3	19	35	
	4	20	36	
	5	21	37	
	6	22	38	
	7	23	39	
CAN NOT BE USED FOR GREEN	8	24	40	RED FILES
	9	25	41	
	10	26	42	
	11	27	43	
	12	28	44	
	13	29	45	
	14	30	46	
	15	31	47	

The specific number of file names for green or red will depend on the user's requirements. Since there are only sixteen files for green and red, file management is important.

# Appendix **E**

## 1350A Modified ASCII Character Set

Decimal Value	Octal Value	Character	Decimal Value	Octal Value	Character
3	003	ETX	46	056	
8	010	Backspace	47	057	/
9	011	Inverse Line feed	48	060	0
10	012	Line feed	49	061	1
11 *	013	Vertical Tick Mark (   )	50	062	2
12 *	014	Horizontal Tick Mark( — )	51	063	3
13	015	Carriage Return	52	064	4
14 *	016	X Marker Symbol	53	065	5
15 *	017	Rectangle Symbol 	54	066	6
19	023	Pointer (←)	55	067	7
20	024	DC4	56	070	8
30 *	036	Diamond Symbol 	57	071	9
32	040	space	58	072	:
33	041	!	59	073	;
34	042	"	60	074	<
35	043	#	61	075	=
36	044	\$	62	076	>
37	045	%	63	077	?
38	046	&	64	100	@
39	047	'	65	101	A
40	050	(	66	102	B
41	051	)	67	103	C
42	052	*	68	104	D
43	053	+	69	105	E
44	054	,	70	106	F
45	055	-	71	107	G

**NOTE:** These are plotting characters that do not automatically advance the beam to the next character starting point. They are useful when drawing graphs. The beam is left at the center of the character.



Decimal Value	Octal Value	Character
---------------	-------------	-----------

72	110	H
----	-----	---

73	111	I
----	-----	---

74	112	J
----	-----	---

75	113	K
----	-----	---

76	114	L
----	-----	---

77	115	M
----	-----	---

78	116	N
----	-----	---

79	117	O
----	-----	---

80	120	P
----	-----	---

81	121	Q
----	-----	---

82	122	R
----	-----	---

83	123	S
----	-----	---

84	124	T
----	-----	---

85	125	U
----	-----	---

86	126	V
----	-----	---

87	127	W
----	-----	---

88	130	X
----	-----	---

89	131	Y
----	-----	---

90	132	Z
----	-----	---

91	133	[
----	-----	---

92	134	√
----	-----	---

93	135	]
----	-----	---

94	136	†
----	-----	---

95	137	—
----	-----	---

96	140	\
----	-----	---

97	141	a
----	-----	---

98	142	b
----	-----	---

99	143	c
----	-----	---

Decimal Value	Octal Value	Character
---------------	-------------	-----------

100	144	d
-----	-----	---

101	145	e
-----	-----	---

102	146	f
-----	-----	---

103	147	g
-----	-----	---

104	150	h
-----	-----	---

105	151	i
-----	-----	---

106	152	j
-----	-----	---

107	153	k
-----	-----	---

108	154	l
-----	-----	---

109	155	m
-----	-----	---

110	156	n
-----	-----	---

111	157	o
-----	-----	---

112	160	p
-----	-----	---

113	161	q
-----	-----	---

114	162	r
-----	-----	---

115	163	s
-----	-----	---

116	164	t
-----	-----	---

117	165	u
-----	-----	---

118	166	v
-----	-----	---

119	167	w
-----	-----	---

120	170	x
-----	-----	---

121	171	y
-----	-----	---

122	172	z
-----	-----	---

123	173	π
-----	-----	---

124	174	
-----	-----	--

125	175	→
-----	-----	---

126	176	Σ
-----	-----	---

127	177	┐
-----	-----	---

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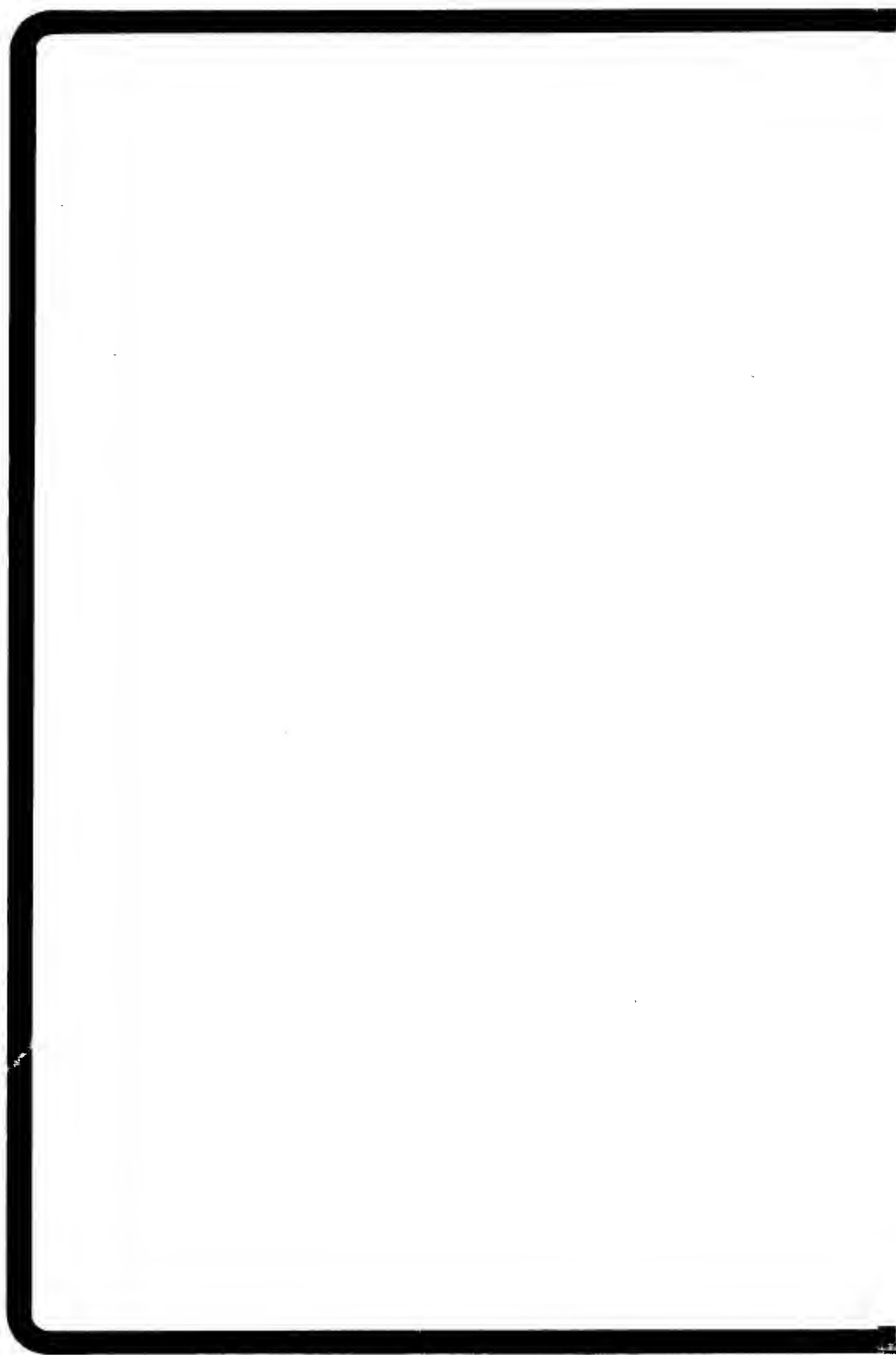
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## 1350A Functions and Command Subsets

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**Note:** See pages 9 and 10 for parameters and syntax.



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